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Electric light companies in the large cities find that the demand for light is increasing. Electric current for lighting and power purposes is developing new uses constantly.

In these times, when over-capitalized companies see their stocks quoted below par, it is gratifying to the electrical fraternity to see how well the electrical stocks hold their own. Lighting and power companies are among the safe investments and are the last to be affected by market panics. There is a regular demand for light and transportation that makes franchise stocks of this nature a particularly safe investment.

BRITISH STANDARDS IN ELECTRICAL ENGINEERING.

The necessity for standardization in all branches of electrical engineering has been recognized for some time, and several years ago the American Institute of Electrical Engineers appointed a committee which reported very fully. More recently the matter was taken up in England more officially, and a committee, representing the various branches of the government interested, the manufacturers, and users of electrical machinery, was appointed to give the matter consideration. The report of this committee deals merely with direct-current voltages and alternating frequencies. The problem was approached from the point of view of those most affected—that is, the users of lamps and motors for power purposes. It was agreed that the standard pressures suggested should be measured at the consumers' terminals. It was also thought advisable to suggest the minimum number of standard pressures and frequencies which would best meet the commercial requirements, and at the same time utilize to the fullest extent consumers' existing appliances.

Report of British Standardization Committee.

After much consideration, the committee decided that the direct-current pressures which would best meet the requirements were 110, 220, 440 and 550 volts for light and power supply. Slight variations from these values will not require redesign of the mechanical parts of the machinery, as by using the standard carcass and by altering the winding alone, a variation of ten per cent above or below the suggested standards can be secured. For tramway service, 500 volts is suggested, and for railways, 600 volts. The frequencies adopted for alternating current were twenty-five and fifty. Although it might seem desirable to have an intermediate value for rotary converters, the committee decided to adopt the two mentioned only. Twenty-five cycles is the standard recommended for systems involving conversion to direct current by means of rotary converters, for large power schemes over long distances, and for polyphase railway work. For mixed lighting and power supply, for factory power plants, and for all medium-sized plants, where rotary converters are not employed, the standard recommended is fifty cycles.

Little Difference between British and American Standards.

These recommendations differ but little from the standards adopted by the American Institute. The corresponding recommendations in the Institute report were 110, 220 and 500 volts for low-voltage supply, and twenty-five or thirty, forty, sixty and 120 cycles for alternating-current supply. The Institute report also recommended generator voltages which were fifteen per cent higher than the terminal voltage, and further recommended certain standards for high-tension alternating transmission lines.

International Standardization.

It is possible that the question of international standardiza-

tion for electrical apparatus may come up at the meeting of the International Electrical Congress, which will be held at St. Louis next fall. And, after a comparison of the American Institute report and the British Standardization Committee report, it would seem that there should be little difficulty, so far as England and this country are concerned, in coming to some definite agreement.

OSMIUM LAMPS.

The search for a material having a higher luminous efficiency than carbon and which can be used to replace the latter for the incandescent lamp filament has given us the Nernst lamp, the osmium lamp and a number of other types which can hardly be said to have passed the experimental stage. Of these the Nernst lamp stands alone as, due to the peculiar properties of the material used in constructing the glower, the lamp as put out differs greatly from the incandescent lamp which is a simple glass bulb containing a conductor of high resistance that becomes incandescent when a current of electricity is passed through it. The osmium lamp, on the other hand, is identical in form with the familiar carbon lamp, except that the osmium filament is longer. In one attempt to improve the incandescent lamp, the carbon filament was subjected to a treatment which produced a layer of carbide on the surface. This, it was thought, would allow the filament to be run at a higher temperature and hence with a higher efficiency, but nothing has been heard of this lamp for some time.

Difficulties in the Use of Osmium.

The difficulties to be contended with in the development of the osmium lamp are the low resistance of the osmium as compared with carbon; the filament when incandescent loses much of its rigidity and osmium is considerably more expensive than carbon. The low resistance necessitates a long filament and the loss of rigidity makes it necessary to support the filament by insulating stays, a construction which is made more necessary and more difficult by the length of the filament. The cost of the material is of less importance, if osmium can be secured in sufficient quantity to make its use for this purpose possible, as the greater efficiency in the production of light of the osmium lamp as compared with the carbon lamp will soon compensate for the greater cost.

Range of Voltage Increased.

The low resistance of osmium has made it possible to construct lamps for low voltages and large candle-power only. Until recently the lamps were made for not more than forty volts and twenty-five to thirty candle-power. Now, it is reported, the Austrian Gasghühlicht and Elektricitäts-Gesellschaft, of Vienna, supply lamps for fifty-five volts, and it is not improbable that the range will be increased.

Tests of Osmium Lamps.

The life and economy of these lamps are shown by the following figures from a report made by Dr. W. Wedding, professor of the Technical College, of Berlin: Two groups, consisting of six thirty-seven-volt lamps each, were submitted early in January and connected by him in series across a 220-volt circuit. In group one, for the first 3,132 hours the average life of the six lamps was 2,853 hours, and the average candle-power fell from 30.1 to 23.7. The mean consumption per candle-power rose from 1.46 to 1.78. After 520 hours the first lamp collapsed, and after 3,724 and 3,940 hours, respectively, two others gave way, the remaining three still burning after 3,973 hours. In group two, which consisted of six twenty-five-candle-power lamps, the report gives the average life as 1,479 hours, the candle-power dropping in 2,198 hours from 25.1 to 19.9, and the energy consumption increasing from 1.37 to 1.75 watts per candle-power.

Increased Economy Increases the Output of the Station.

If lamps of this character can be turned out in commercial quantities, and at commercial prices, they would form a most important advance in electric lighting, as they would largely increase the possible output of every lighting station. As a mechanism, nothing better than the carbon incandescent lamp could be desired, but as a producer of light it is very far from perfect.

WHERE PHILADELPHIA LEADS.

From time beyond memory the city of Philadelphia, Pa., has, for one reason or another, been inflicted with a reputation of moving in old-fashioned and conservative ways. Probably there was a period in the history of this municipality when it did not seem to fall in with the quick-step at which its neighboring communities were pacing. But mark this! Philadelphia is alive to its opportunities; and its appreciation and utilization of electrical apparatus make this certain. Its street railway systems are equal to the best. We do not hear a grumble as to its lighting facilities. Its telephone system is growing by leaps and bounds, and now it comes to the front, to the shame of other municipalities, and inaugurates the carriage of the United States mail in electric wagons. This service has been established after a careful enquiry, and the results already achieved bid fair to encourage the universal adoption of the electrical vehicle for this service.

INTEREST IN INSTITUTE LOCAL SECTIONS.

A healthy interest is being shown in the various local sections of the American Institute of Electrical Engineers. Twenty-one sections have already been established, the greater number of which holds meetings monthly, and reports show that these meetings have been well attended. At certain sections the work is more active, as meetings are held two or three times during the month.

Although the greater number of these meetings is devoted to the reading and discussion of papers which have been presented at the general meeting of the Institute, some interesting original papers have been contributed to several local sections. This is a desirable move, as at such meetings papers of local interest can very properly be presented, although the sections do not seem to be limiting themselves to papers of this description. As the success of the local sections depends upon maintaining the interest of the members, the outlook is very promising.

The electric railway companies have had little use for snow plows so far this season. But these snow removers should be overhauled and made ready. There will be much use for them yet, and generally when least expected.

The Lachine Rapids Power-House of the Lachine Rapids Hydraulic and Land Company, Limited, Montreal.[1]

The Original and Present Arrangement of Generators, Exciters and Switchboards, Etc.

By R. S. Kelsch.

WHEN the power-house was projected, plans and designs got out for the generators, switchboards, etc., there existed very little data regarding the operating of such a plant. Furthermore, the three-phase system in this country was not very far advanced, and there was more or less uncertainty as to how the output of this plant would be disposed of.

Under these conditions considerable temporary work was done and the plant was operated under difficulties. However, after operating some time, it was self-evident that a widely different plan for controlling the machinery and electrical apparatus must be worked out.

The disadvantages of the original layout were the poor regulation obtained, because of the exciters being driven direct from the main shaft, the speed of the exciters changing with changes in load, which multiplied the voltage regulation, and made it impossible to obtain good regulation. The switchboard arrangement, consisting of a separate switchboard located with each of the four generators, could be operated only at a great disadvantage. The position of the switchboard was such that the operator could not see the water-wheel attendants.

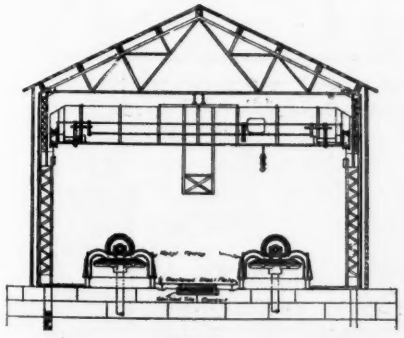


FIG. 2.

Considerable difficulty was experienced in operating the plant so as to give good service with the above arrangement and several changes were made which will be described. Referring to Fig. 1, water-wheel regulator "R" has been changed and a different type installed—the new governors are of the Lombard make, controlled from the switchboard.

The exciters marked "E" have been removed and located midway between the three generator rooms, each exciter being driven by an independent water-wheel, so that any speed change of the main shaft, due to change of load, does not affect the exciter regulation. By referring to the section view, Fig. 2, it is seen that the original wooden floor has been removed. The old hand crane has been replaced by a modern three-motor electric traveling crane and the overhead wires have been replaced by lead-covered cables placed in vitrified tile conduits, which are located below the new steel plate floor. The floor directly under the main shafts has been removed, leaving the flumes open, which permits ready inspection, facilitates making of repairs, and removes the possibility of the floor catching fire from hot bearings, etc. A closed iron fence has been built the entire length of the power-house, as shown, which serves the double purpose of preventing any one from falling into the open flumes and also prevents oil and grease from being thrown from the crown gears out on to the floor.

Instead of the three separate switchboards, one main switchboard has been built in the centre dynamo room, as shown on Fig. 1, and from the operator's position on the top gallery a good view is obtained of the entire power-house, including the generators, water-wheel governors, exciters, etc.

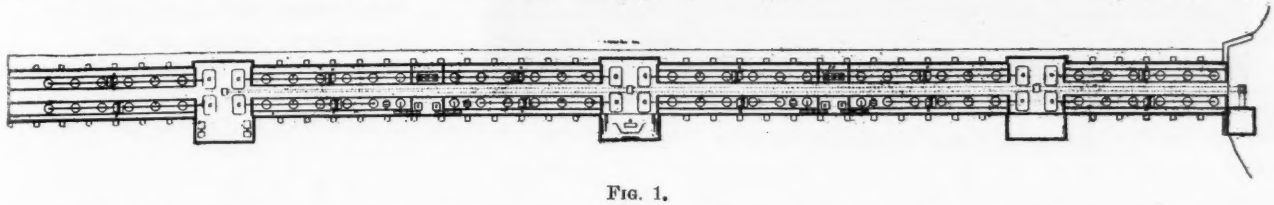


FIG. 1.

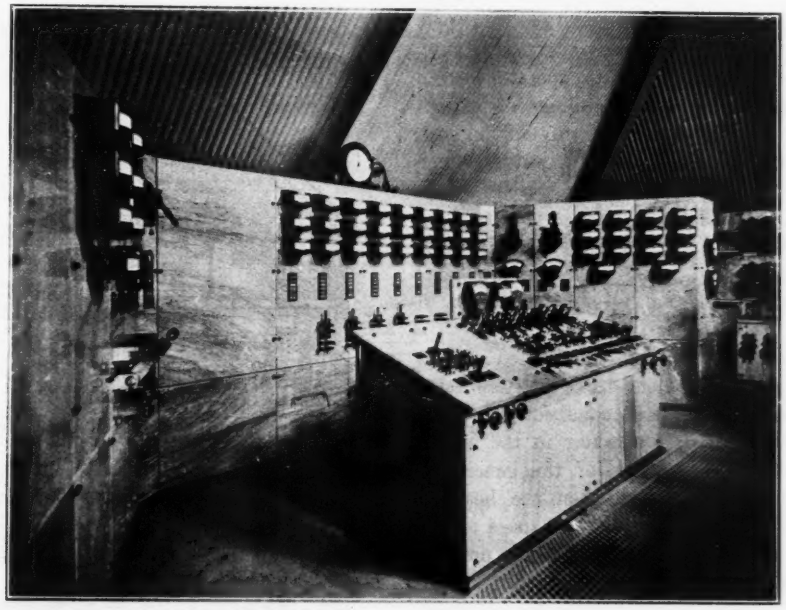


FIG. 3.—MEASURING INSTRUMENTS AND BENCH BOARD, LACHINE RAPIDS POWER-HOUSE.

GENERATORS AND EXCITERS.

The power-house is 1,000 feet long and 50 feet wide. The generator rooms are about 300 feet apart and in each of the generator rooms there are four generators.

[1] Abstract of paper read at a meeting of the electrical section of the Canadian Society of Civil Engineers at Montreal, October 15

They are the well-known type of revolving field machine, made by the General Electric Company, and are of 750-kilowatt capacity each, having forty poles and a speed of 180 revolutions per minute, the frequency being sixty cycles and the voltage 5,000. In each of the exciter rooms there are two compound-wound seventy-five-kilowatt exciters, furnished by the General Electric Company. They are four-pole and run at 660 revolutions per minute. These exciters are built to operate between 90 and 175 volts. The voltage varies considerably, depending not only on the load, but also on the head of water, which changes with the different seasons of the year. It was found necessary to use several small exciters instead of two of larger capacities, on account of the low head during winter months, and the capacity of each wheel being limited.

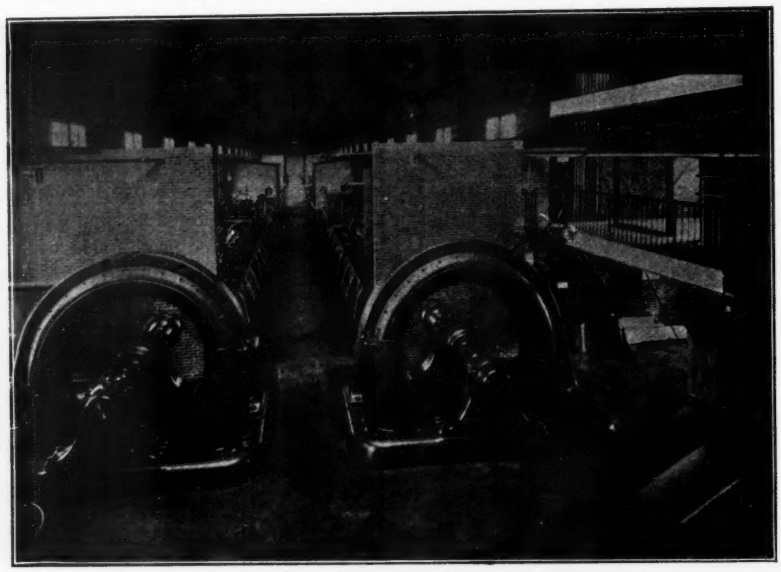


FIG. 4.—ROTARIES, LACHINE RAPIDS POWER-HOUSE.

The generators are constructed so that the fields are about three-quarters saturated under normal conditions, so that in the event of low water in the winter time the full voltage of the generators could be maintained when the head of water is reduced so that the speed of the generators is ten per cent below normal. In addition to these four exciters, there will be installed in the south dynamo room in the space originally occupied by the first temporary switchboard, two seventy-five-kilowatt direct-current generators, direct-connected to three-phase motors which will supply the current for the electric traveling crane, electric heaters, and the station lighting.

The main objects aimed and arrived at in the design of the switchboard were:

First, highest degree of safety and best results of operation.

Second, flexibility combined with the greatest simplicity possible.

Third, the impossibility of any but a wilful mistake on the part of the operator.

Fourth, the control of the entire system, including the turbine governors, to be such as to require only one operator on the switchboard.

Fifth, dividing the switchboard into symmetrical sections and the highest grade of work.

Sixth, fireproofing and insulating of all conductors, etc.

Sixteen feeder circuits are provided for and, as has been shown, twelve generators. It was considered advisable and an advantage to separate them into four sections, each set of three generators feeding four feeders. The arrangement is such that there are practically four different power-houses, each set or power-house being possible of entirely separate operation, or of working in multiple, the bus-bars being tied together or separated by means of electrically operated tying oil switches.

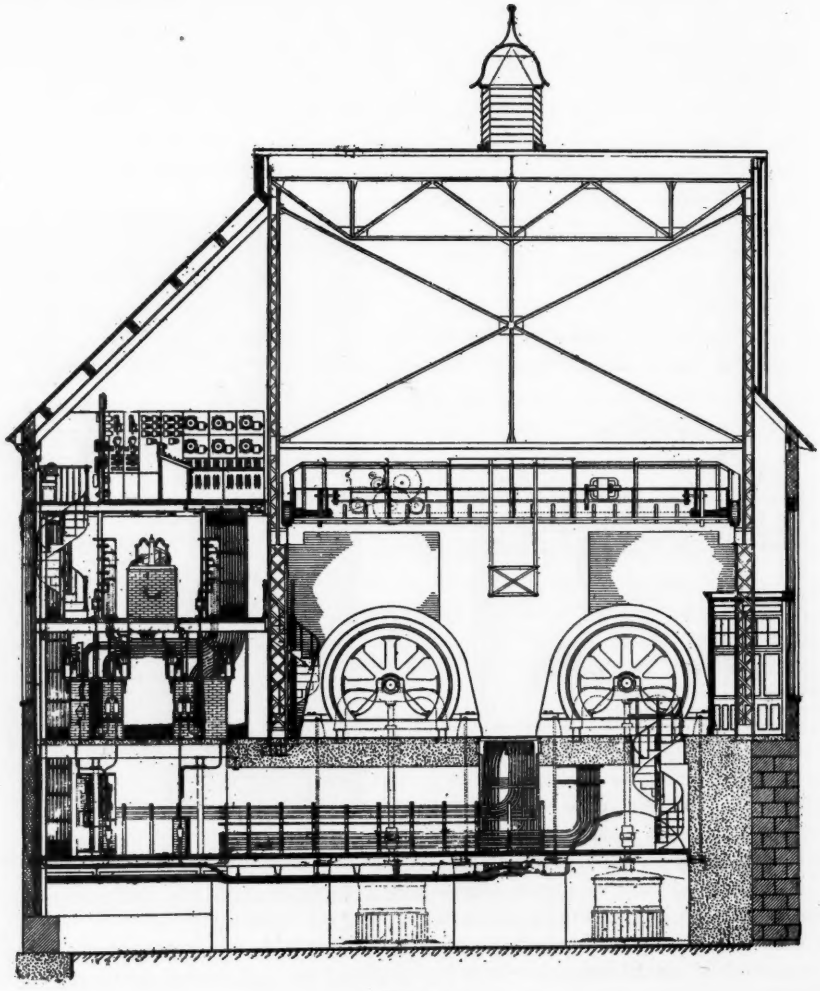


FIG. 5.

For each set of three generators and for each set of four feeders, there

is a separate set of bus-bars. Each set of generator bus-bars is tied to the corresponding set of feeder bus-bars by means of cables, forming one complete section, the tying switches being tapped off these cables and not off the bus-bars.

Both the generator and feeder bus-bars form separate switchboards and are entirely independent and away from each other. This arrangement permits the entire system to be tied together and run as one system, or it may be run as separate systems.

In the event of an accident to any portion of the system, it can be quickly separated from the rest until repairs are completed. The arrangement is such that during light loads on Sundays and holidays, nights, etc., any portion of the plant can be made dead throughout, permitting any repairs, cleaning, etc., that may be necessary, without the slightest chance of injuring an employé.

Of the four feeder switches on each section only three are for transmission lines to the substations in the city, there being thus twelve lines altogether. The fourth switches are for reserve and for transmission of power to the surrounding neighborhood, etc.

In the plan as laid out, if there should be a compulsory shutdown of one of the feeder bus-bar panels, by disconnecting the cables from the latter the generators on that section can still be utilized. On the other hand, if a generator bus-bar panel be put out of service, the feeders on that section can be fed from the other generators. In the circuits of the tying switches are current transformers which operate overload relays. The latter are adjusted to operate only in case of an unusual and very heavy current such as can be obtained only by a dead short-circuit on the bus-bars. In such a case, the tying switches will automatically cut off the faulty section from the rest and prevent a complete shutdown of the plant.

For the four exciters, there are two sets of bus-bars, each exciter has a double-throw four-pole switch, besides the other switching apparatus on the exciter panels, as will be described later. It may happen that one of the exciters will become disabled, and in such case one of the motor-driven direct-connected generators installed in the south dynamo room will take its place, utilizing the same exciter panel.

THE CABLE SUBWAY.

As has been stated, the power-house is 1,000 feet long and to provide means of conducting the cables through the power-house to connect with the transmission line, a fireproof subway is run through the entire length of the power-house with manholes in each of the dynamo rooms and one outside of the power-house entrance, where the subway enters the tower, this subway consists of vitrified conduits laid in concrete.

THE MAIN CABLES.

The generator and feeder high-tension cables are constructed for 10,000-volt working pressure. They are three conductor No. 0 B. & S. cable, each conductor has seven-thirty-seconds inch paper insulation, and the whole covered with a lead sheeting. These cables run through the conduits to the middle dynamo room manhole, then along the basement corridor walls to the cable-head cells. Wherever the cables are exposed outside of the conduits, they are covered with three layers of asbestos tape, each layer being three-sixteenths inch thick, and the whole fastened on with brass straps. The cable heads are all mounted in brick cells and consist of brass bushings soldered to the cable, and the flared or bell-shaped cast-brass cable heads are then screwed on to the bushings and the whole filled with No. 66 Edison compound. The feeder cables which run into the tower have at the latter place a similar cable head and brick cell construction.

The exciter generator field and signal cables also run to the middle dynamo room through the conduit system, thence along the ceiling below the basement and then up the walls to the second switchboard gallery on to the main switchboard. It will be seen that by putting all of the high-tension cables in the basement and the direct-current cables in the sub-basement, they are entirely separated from each other. The exciter cables are 600,000 circular mils single conductor. The cables for the generator field are two conductor No. 0 B. & S. and the signal cables are multiple conductor No. 14 B. & S. They are all paper-insulated and lead-covered, made to successfully withstand a breakdown test pressure of 1,500 volts alternating current for one minute.

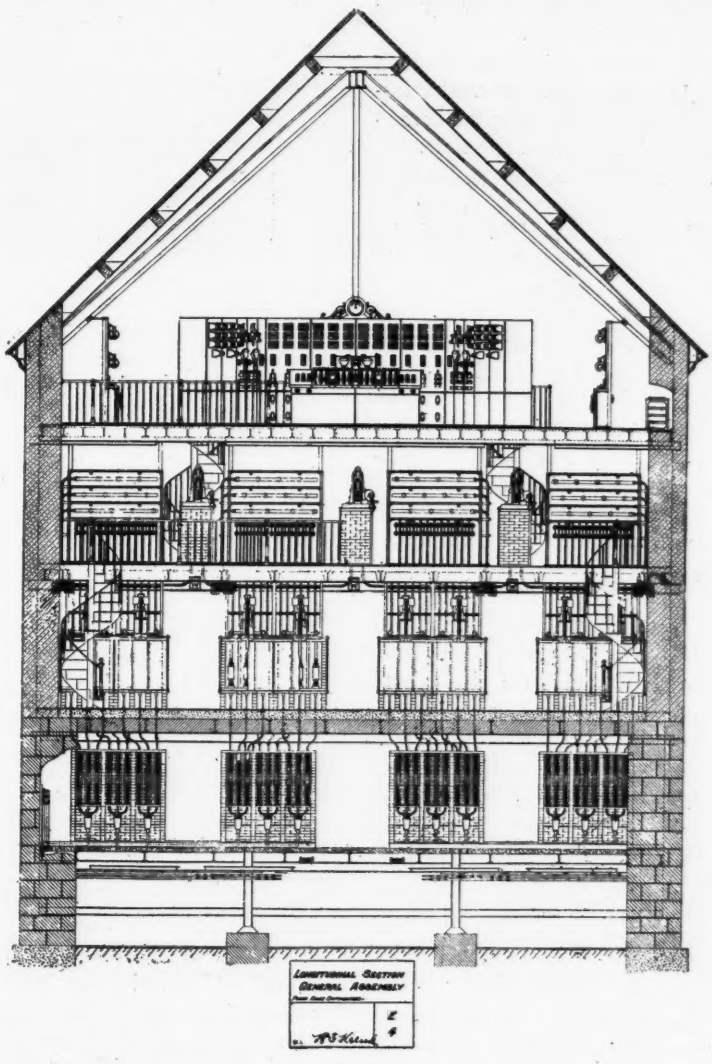


FIG. 6.

THE GENERAL ARRANGEMENT OF THE SWITCHBOARD, SWITCHES, ETC.

The basement is used principally for the cable heads, static arresters and the potential transformers. These are all placed in buff brick cells with soapstone and brick barriers. From the generator cable heads, single lead-covered conductors run up to the oil switches on the main floor; from these switches, lead-covered leads run up to the bus-bars on the first gallery, passing through the current transformers on the back of the bus-bar panels.

The tying cables which pass through the totality instruments and current transformers connect the generator bus-bars to the feeder bus-bars on the same floor.

The feeder cables connect to the bus-bar panels in the same way. There are on the main floor, twenty-eight electrically operated oil switches grouped together in threes for the generator and in fours for the feeders. Each block of three switches for the generators has two corner cells in each of which is placed a 500-watt potential transformer with its primary and secondary fuses. These transformers are for operating the instruments of that section and are connected to the 5,000-volt bus-bars.

On the first gallery are located the bus-bar panels and also the electrically operated tying switches for the bus-bars. On the second gallery is concentrated the control of the entire power-house. On this floor is located the instrument panels and the operating table. Also on the right and left hand are the two feeder bench boards and adjoining these are the direct-current distributing switchboards for supplying power to all of the auxiliaries.

On this gallery, where the operator is stationed, there will be absolutely no high-tension wiring or apparatus of any description.

MAIN SWITCHBOARD.

The main switchboard (Fig. 9) consists of four generator panels in the centre, two spacing panels, four exciter panels and four total output panels and at each end of the board is a panel for the recording instruments.

On the back of this board are two sets of exciter bus-bars mounted on fibre block insulators, supported by cast-iron brackets and insulated with oil linen and tape.

It is possible to disconnect the exciter bus-bars into three separate sections for repairs, etc. Each panel provides for three generators and each generator has on this board a power-factor indicator, one alternating-current ammet r, one direct-current field ammeter, two reverse current relays and double-pole, double-throw field switch with discharge resistance and an annunciator or signaling device. No overload automatic devices or fuses are provided for the generators.

In case of any short-circuit in the generator cable or in case of the field current failing, the other generators would of course pump back into this disabled machine and thus reverse the current. The reverse-current relays will then automatically cut off the faulty cable or generator from the bus-bars. In case that the generators when in parallel fail to work together, then the power-factor indicator will indicate the trouble, and the reverse-current relays will again operate. On the back of this board are fuses for the field cables, and these fuses are set for three times normal full load, so that they can only operate in case of a dead short-circuit on the field or cables connected thereto.

On each exciter panel there are a triple-pole double-throw switch, a circuit-breaker, a Thomson astatic ammeter and an illuminated annunciator.

On each totality panel are mounted two wattmeters, three ammeters, a frequency indicator and the bus-bar voltmeter.

OPERATING TABLE.

The operating table is divided into sections corresponding with the rest of the system. There are four panels for the generators, between each two of which is a panel for the control of the bus-bars tying switch. A simple inspection shows whether the controlling switch of the tying switch is closed or not, which is indicated by colored pilot lamps.

On the two extreme ends of the table are the panels for the exciters. The operating table contains all the necessary apparatus for the automatic and hand control of the oil switches, for the control of the motor-operated field rheostat switches, of the motor-operated main rheostats for the exciters, of the turbine governor control, the signal system, a synchronizing device and the alternating-current voltmeter for the generators and the direct-current voltmeters for the exciters.

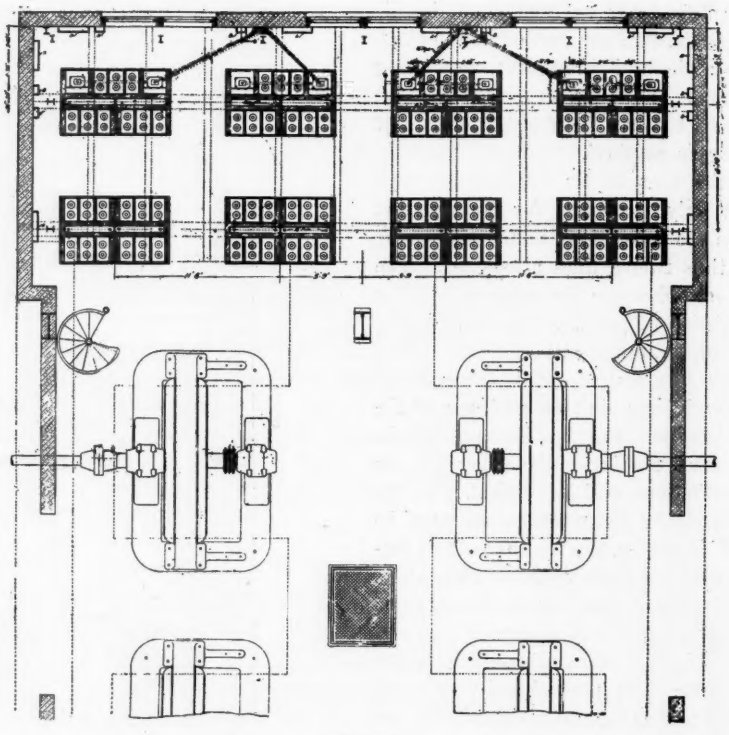


FIG. 7.

THE FEEDER BENCH BOARDS.

On the feeder bench boards are mounted the overload relays, the automatic controlling switches and the red and green pilot lamps for the same. According to whether the red or green lamp is lighted, can be seen whether the oil switch on the main floor is open or closed. No instruments whatever are provided for the feeders, as most of the feeders run to one distributing point, but by means of the terminal board it is possible to put ammeters, wattmeters, etc., in on any feeder and on any phase.

THE DIRECT-CURRENT DISTRIBUTING SWITCHBOARD FOR THE AUXILIARIES.

These switchboards, of which there are two, are mounted alongside of the feeder bench boards. On them are mounted the fuses for all the supply leads of the direct-current controlling or auxiliary devices, the source of energy being from either set of the exciter bus-bars.

THE MOTOR-OPERATED MAIN RHEOSTATS FOR THE EXCITERS.

These rheostats are mounted on the floor in the rear of the main instrument switchboard. There are two sets of these, one for each set of exciter bus-bars. Each set contains four rheostats operated simultaneously by means of a worm shaft driven by half horse-power direct-connected motor.

By means of special clips, the triple-pole double-throw switch on the exciter panel, depending on its position, throws a rheostat of one of the two sets in series with the hand-operated shunt field rheostat of the corresponding exciter. The latter rheostat is mounted underneath the ceiling floor of the second gallery, and is controlled by means of sprocket chain gearing from the operating table. On the operating table are mounted the controllers for these rheostats. The object is to raise or lower the voltage simultaneously on all exciters which are in multiple, and thus to simplify the operation.

ALTERNATING-CURRENT BUS-BARS.

The high-tension bus-bars (Figs. 10 and 11) situated on the first gallery are mounted on soapstone panels, two inches thick, with soapstone barriers. The current is carried from the oil switches through the current transformers to the knife blade switches and thence to the bus-bars studs by means of copper bars. The knife blade switches serve the purpose of making the oil switches entirely dead for cleaning and for repair purposes. On the back of the panels the connecting strips and terminals are well insulated.

OIL SWITCHES.

On the main floor for the generator and feeder switches, there are twenty-eight compartment type oil switches furnished by the General Incandescent Arc Light Company, of New York. These switches are mounted in a buff brick chamber, divided by soapstone barriers into three compartments, one for each phase. On the first gallery for the three tying switches are three compartment type switches, they being the well-known General Electric Company's compartment switch.

GOVERNING CONTROLLERS.

One of the interesting features of the plant is the controlling device for the Lombard water-wheel governors, by which the speed of the water-wheels driving the generators is electrically controlled from the operating table. Inasmuch as the wheelman in any case is required to start the wheels and to open the valves on the governor, and to bring the water-wheels and generator up to approximately normal speed, it was decided that the best plan would be to let the wheelman start up each unit and after bringing the generator to approximately the right speed, to give the switchboard attendant only such control as may be necessary to get the generator in synchronism.

Two solenoids operate the rachet wheels which are fixed to the spindle or rod which connects the flyball with governor-regulating valve. One of these solenoids operates a rachet in one direction so as to raise the speed, and the other solenoid operates another rachet in the opposite direction, which lowers the speed. On the operating table there is a single-pole double-throw cam switch which controls simultaneously or singly all the governors in the power-house.

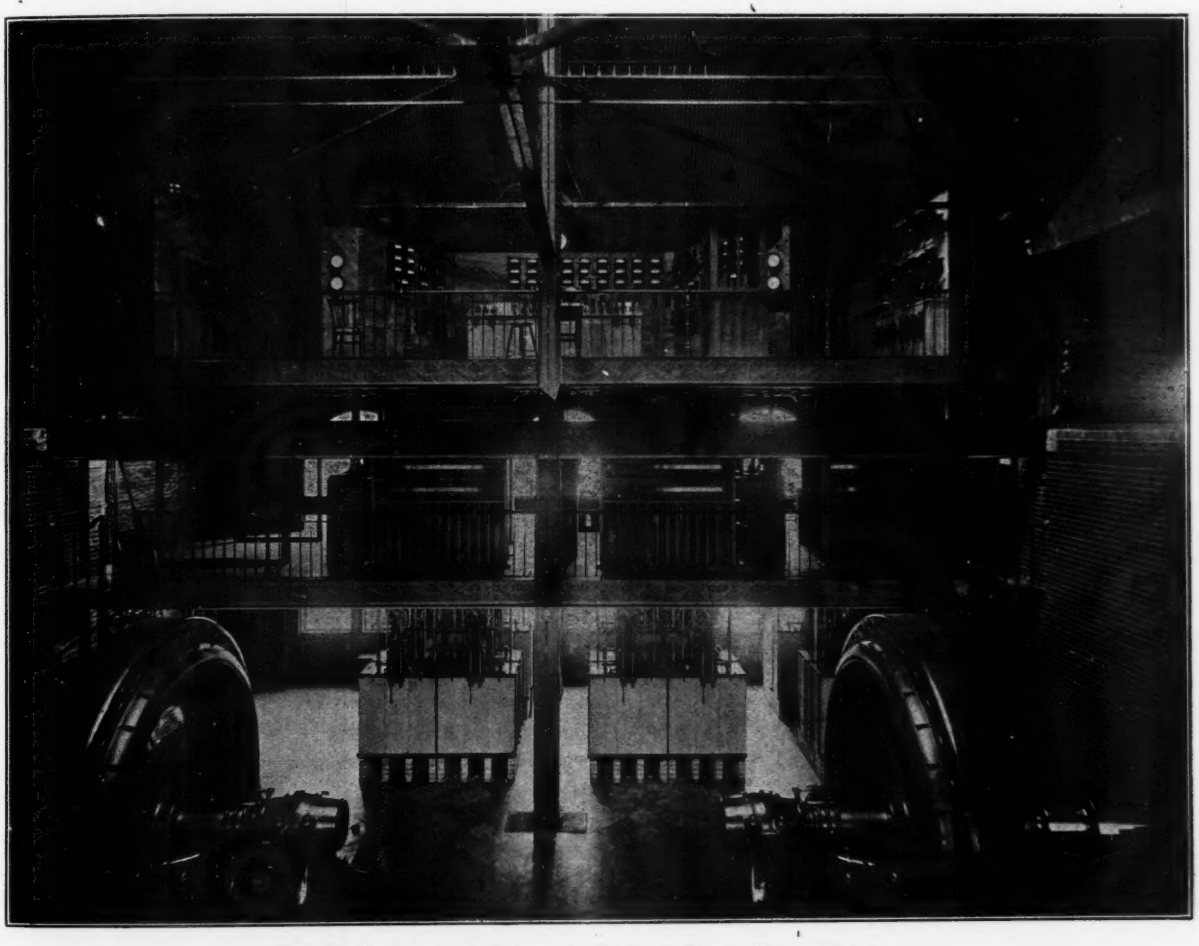


FIG. 8.—SWITCHBOARD GALLERIES, LACHINE RAPIDS POWER-HOUSE.

THE SIGNAL SYSTEM.

On the generator and exciter panels, annunciators are mounted. Each annunciator has six compartments with ground glass covers, back of which are two five-candle-power seventy-five-volt lamps, connected in multiple, and on each piece of ground glass is printed certain signals. These lamps are operated from single-pole double-throw cam switches mounted on the operating table. Similar annunciators and switches are mounted at each turbine governor, and the lamps here are in series with those on the main switchboard. At each end relays operate electric bells, thus calling attention to the signals.

THE SYNCHRONIZING DEVICE.

There is only one Lincoln synchronizer

used and there are four different sets of bus-bars for each generator, and for each bus-bar tying switch there is one four-hole receptacle on the operating table. If the operator wishes to synchronize two sets of bus-bars he inserts the four-point plug on the corresponding tying panel. If he wishes to synchronize a generator with the bus-bars, the plug is inserted in the corresponding four-hole receptacle. The operator need not see that the synchronizer is on the right bus, as the four-point plug takes care of that.

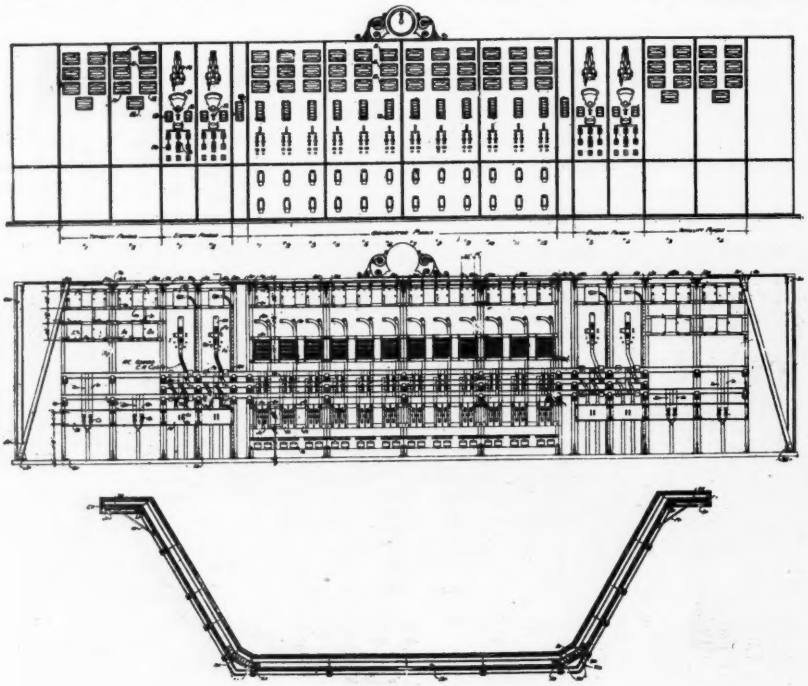


FIG. 9.

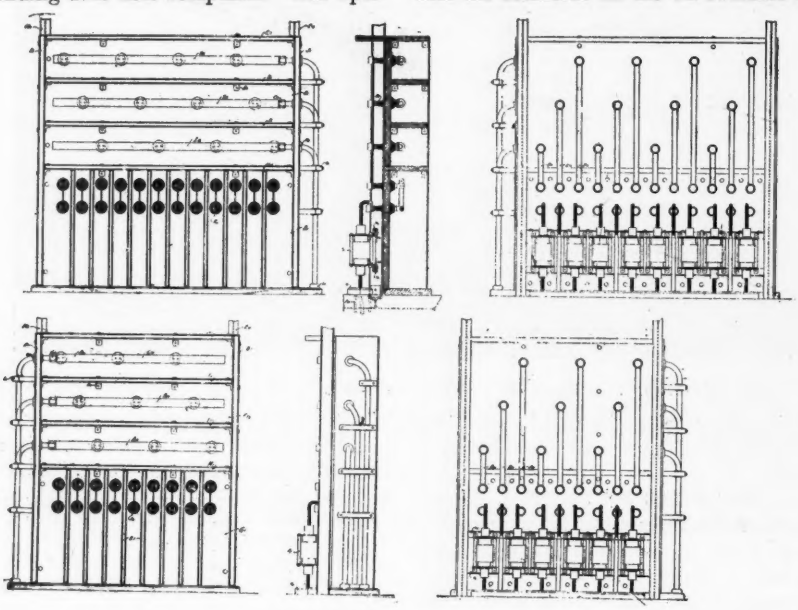


FIG. 10.

GENERAL.

The various diagrams clearly show the methods of operation for the alternating-current and direct-current systems. It remains to be said, that the overload relays for the feeders and reverse-current relays for the generators, when subjected to the automatic controlling switches, on the abnormal conditions they are set to operate at, close a direct-current circuit through the trip coil of the corresponding feeder bench boards or operating table as the case may be, which in its turn actuates the solenoids on the oil switches and opens the latter. With the overload relays for the tying switches, the operation is different. In this case, the trip coil of the controlling switch is under normal conditions short-circuited through the relay contacts. When the overload occurs the contacts are open-circuited, which sends the current from the series transformer through the trip coil and thus opens the main switch. All the current and potential transformers have in either case the secondary wiring grounded, so there is no chance of injury in case the insulation breaks down.

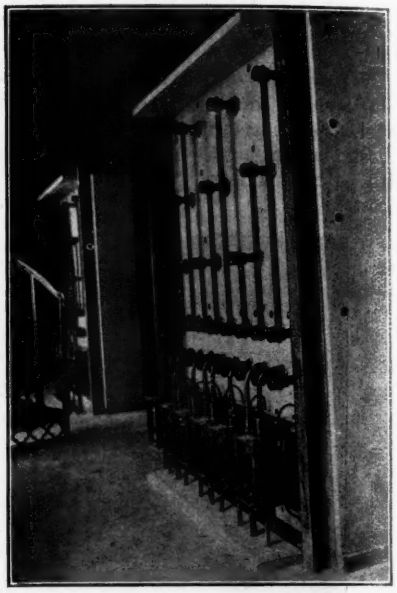


FIG. 11.—HIGH-TENSION BUSES.

As the secondary leads of the current transformers run up to the instrument switchboard, on the floor above, are consequently rather long, the leads are twisted to avoid any inductive effect which might affect the accuracy of the instruments.

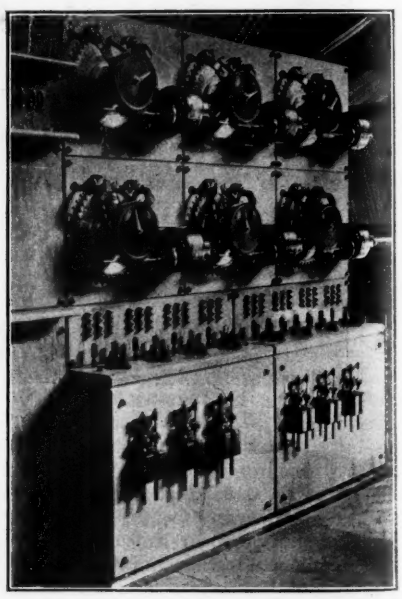


FIG. 12.—MOTOR-OPERATED MAIN RHEOSTATS FOR EXCITERS, LACHINE RAPIDS POWER-HOUSE.

It may be noted that all the wiring throughout the system, except the secondary leads from the current transformers, consists of lead-covered paper-insulated conductors.

The Use of Electricity for Glass Manufacture.

By John B. C. Kershaw.

Introduction.

THE reported success of electrical heating, when applied to the production of iron and steel, has revived interest in the attempts that have for some time been directed toward the use of electricity as a heating agent in the manufacture of glass. The conditions in this industry are very similar to those obtaining in the production of iron and steel. In each case, the furnace used for carrying out the manufacture by the older process is considered to be the most efficient heating appliance in industrial use. The blast furnace, as an agent for converting the energy of coal into heat or chemical action, finds a worthy rival in the regenerative gas furnace, which is now almost universally employed for glass manufacture. The latter furnace is constructed in such a manner that the heat of the waste gases is employed to heat the incoming gas and air. To this utilization of heat which would otherwise be wasted, and to the exact regulation of the air supply possible with gaseous fuel, the furnace owes its strikingly high efficiency as a heating appliance.

When therefore electricians and engineers propose to substitute electricity for gaseous fuel in the manufacture of glass, it is evident they have a somewhat difficult task to fulfil. A further difficulty as regards the adoption of electric glass furnaces is caused by the fact that the gases liberated and enclosed in the glass when first melted take a long time to rise to the surface and escape. In most glassworks a period of twenty-four hours is required for this "clearing" of the glass, and during the whole of this time the glass must be kept in the molten condition. It is certainly yet too early to say that these difficulties have been surmounted, and that this new application of electric power has proved a financial and practical success. However, two experimental works of this kind are in operation, and the methods and furnaces having thus arrived at the industrial stage of their development a detailed account of the new procedure will no doubt prove of interest to readers of this paper.

Details of Construction of the Electric Glass Furnaces.

No very reliable information can be obtained from those exploiting the new processes for glass manufacture as to the exact type of furnace now being used for the industrial trials. The writer has therefore thought it wise to give brief illustrated descriptions of all the more important furnaces for this purpose patented recently in the names of Becker and Voelker, the German engineers who have acted as pioneers in this new development. It is probable that all of these have been tried, and that the furnaces now being employed at Matrei and Plettenberg contain the best features of each of these various designs. Figs. 1 and 2 show two views (back and front) of the seventy-kilowatt Becker furnace, used for the experimental trials in 1902. The internal construction of this furnace, which has two melting canals of the step-hearth type, and two pots for receiving the molten glass, can be arrived at by a study of the following patents.

It may, however, be remarked that the after-heating of the glass in the furnace, shown in Figs. 1 and 2, was effected by coal; and that the waste gases from this portion of the furnace was utilized to heat the annealing furnace, seen on the right-hand side in Fig. 2.

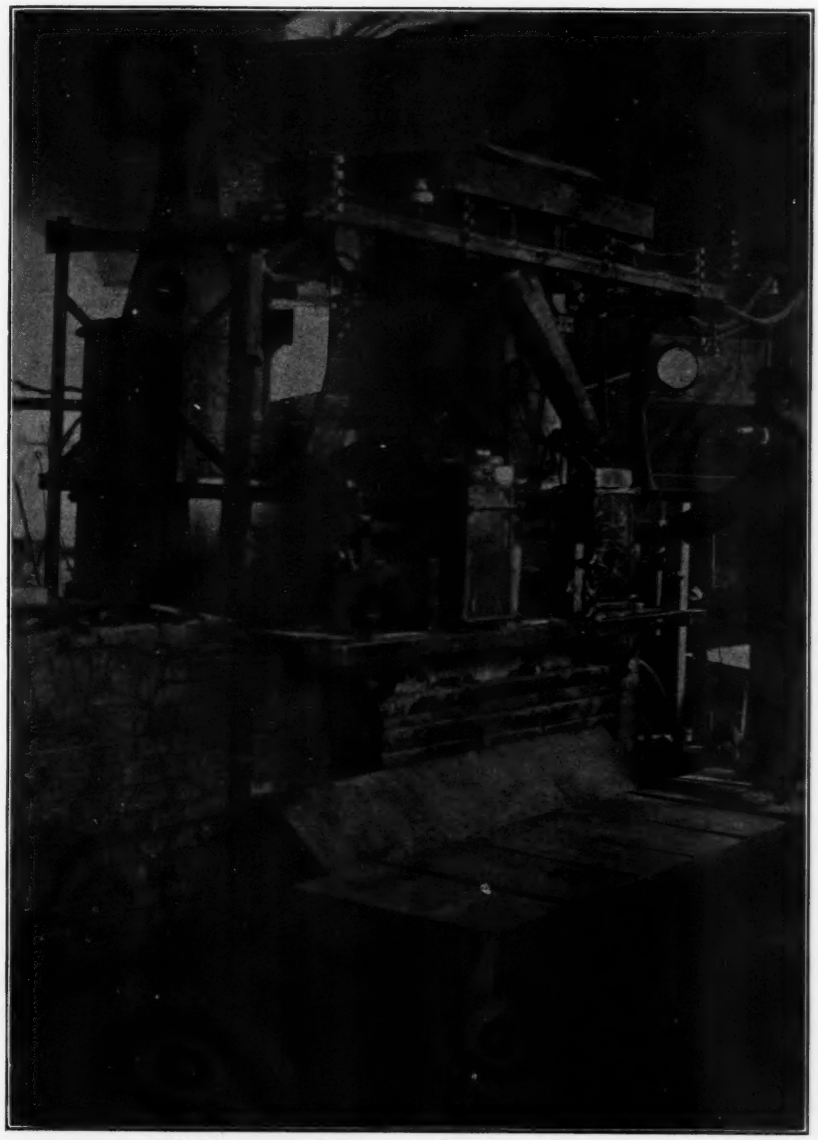


FIG. 1.—AN ELECTRIC GLASS FURNACE—REAR VIEW.

Patent No. 6,944, 1898, Becker and Schreyer.

The furnace described in this patent is shown in sectional elevation in Fig. 4; while Fig. 3 gives details of the series of hearths where the arc-heating of the raw materials occurs. f_1 f_2 f_3 in Fig. 3 and g g g in Fig. 4 represent the electrodes between which the arcs are formed; while c d e in Fig. 4 represent the various di-

visions of the furnace proper, in which the clearing of the molten glass occurs. The step-hearth formation of this furnace appears to be the only feature which has been retained in the latest form of electric glass furnace.

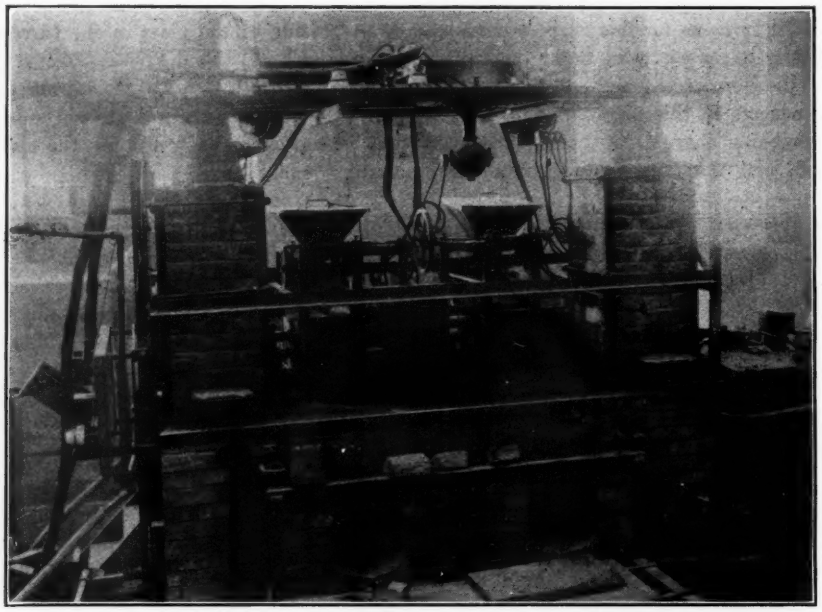


FIG. 2.—AN ELECTRIC GLASS FURNACE—FRONT VIEW.

Patent No. 12,672, 1900, Voelker.

This patent relates to a type of furnace for glass production, in which both arc and resistance heating are employed. The latter method of heating is possible, since molten glass is a conductor of electricity. Fig. 5 is a sectional elevation of the furnace. EE represent the arc electrodes; while *e e* show the position of the electrodes, between which resistance heating occurs. After being cleared in this way in the basin A, the glass flows down into the lower working chamber B.

Patent No. 23,903, 1900, Voelker.

The furnace described in this patent is a modification of that just referred to.

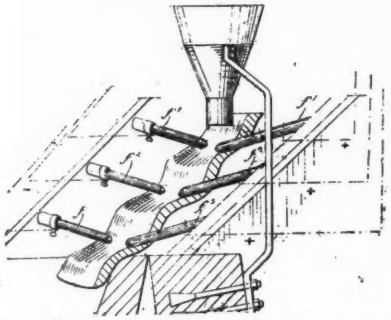


FIG. 3.—MELTING HEARTH OF BECKER'S ELECTRIC GLASS FURNACE.

Fig. 6 is a sectional elevation of the furnace. A number of radial passages, two of which are shown in the diagram CC, convey the raw materials into an equal number of inclined tubes *h h*, where melting by the arcs occurs. Two arcs are formed in each of these tubes, *d d* and *e e* being the electrodes. K is the refining basin, and in this the glass is cleared by aid of resistance heating, *l l* being the two electrodes for this current; *p* is the working pot into which the glass finally passes by the annular ring *n* and openings *o o*.

A feature of this furnace is that the hot gases produced by the melting and reaction of the raw materials are collected, and conducted by the tubes *r r* to the bottom of the furnace, where they are burned with air in the burner S. The heat thus produced is employed to heat the working pot *p*.

Patent No. 17,656, 1901, Soc. Industrie Verriere.

In this patent a radical departure in the method of feeding the raw materials into the furnace from that described in the earlier patents is introduced. The raw materials are ground, formed into a paste with water, or with soluble glass plaster of Paris, etc., and are then passed through a suitable press, and delivered into the furnace in the form of a continuous ribbon or band. When water is used for mixing the band requires a preliminary drying before submitting it to the action of the arc. Fig. 7 is a diagrammatic section of a furnace being fed with raw materials in band form; *e e*, *e e* and *e e* being the three pairs of electrodes, and *d* the melting hearth.

In a letter received in January of the present year by the writer from T. Bronn, the latter, who is one of the directors of the works at Plettenberg, stated that the operation of the furnaces used at that place had been much simplified and improved in the last few months. In Herr Bronn's opinion, these furnaces may now be considered to have entered into competition with the usual form and type of

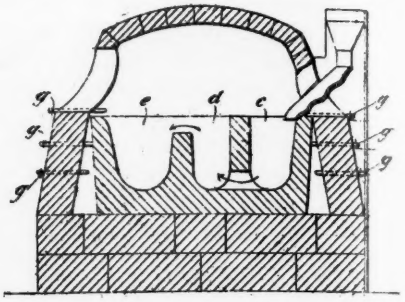


FIG. 4.—BECKER'S ELECTRIC GLASS FURNACE.

glass furnace. The quality of the glass produced was good; and in the latest design, contact with the electrodes did not occur. This overcomes the difficulty caused by disintegration of the carbon of the electrodes, and contamination of the glass with this impurity—a danger which has been referred to by a writer in the paper named below.[1]

The chief American patents relating to electric furnaces for glass manufacture are as follows:

Nos. 664,034; 689,766; 702,081; 706,283; 708,309.

The Industrial Application of Electricity to Glass Manufacture.

As already stated in the introduction

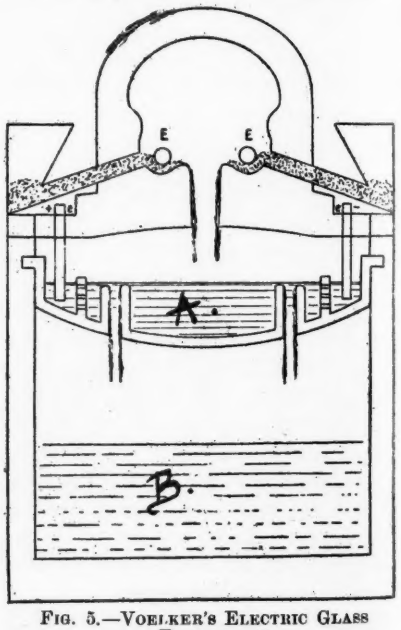


FIG. 5.—VOELKER'S ELECTRIC GLASS FURNACE.

to this article, two works are now in operation where glass is being produced by aid of electrically generated heat. One

[1] *Zeits. f. Elektrochemie*, 1901, p. 811.

of these works is situated in the Tyrol, the other is in Westphalia. All the information available relating to these works is presented below.

The Electric Glassworks at Deutsch-Matrei in the Tyrol.

The present trials at Matrei are under the control of the Aktien Gesellschaft f. Elektrokeramic, an Austrian company founded in 1902, with a capital of 400,000 krone and headquarters in Brussels. This company was promoted by the Allgem. Carbid u. Acetylen Gesellschaft, of Berlin, by the Akt. Gesell. l'Industrie Verriere et ses derives, of Brussels, and by the Akt. Gesell. Carbidwerk Deutsch-Matrei. The latter company provided 3,000 horse-power and placed its land and buildings at Matrei at the disposal of the new company.[1] Manufacturing operations were reported to have commenced in the summer of 1902 at this place. The Matrei carbide works was one of the large number on the continent of Europe which had to suspend operations owing to the fall in carbide prices in 1900 to 1901,

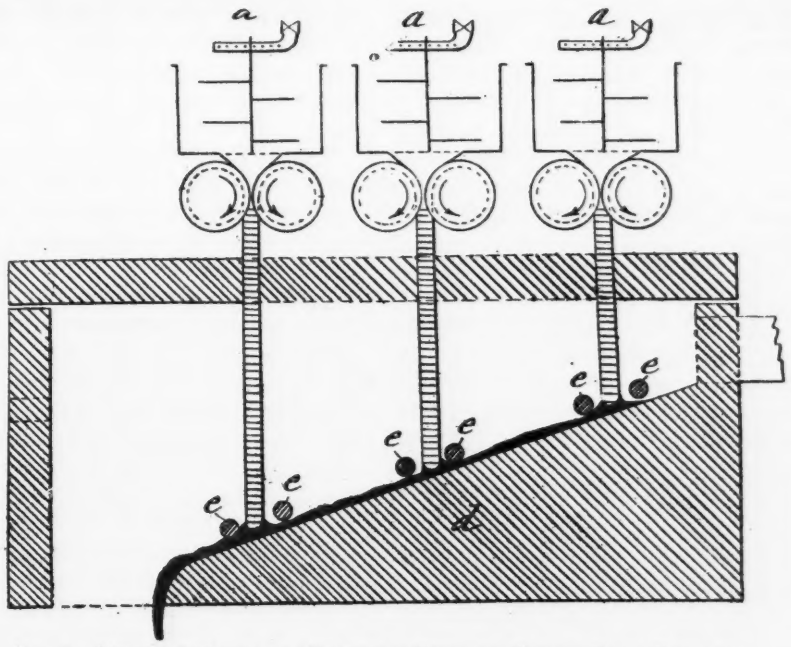


FIG. 7.—SOCIETE ANONYME DE L'INDUSTRIE VERRIERE PATENT GLASS FURNACE.

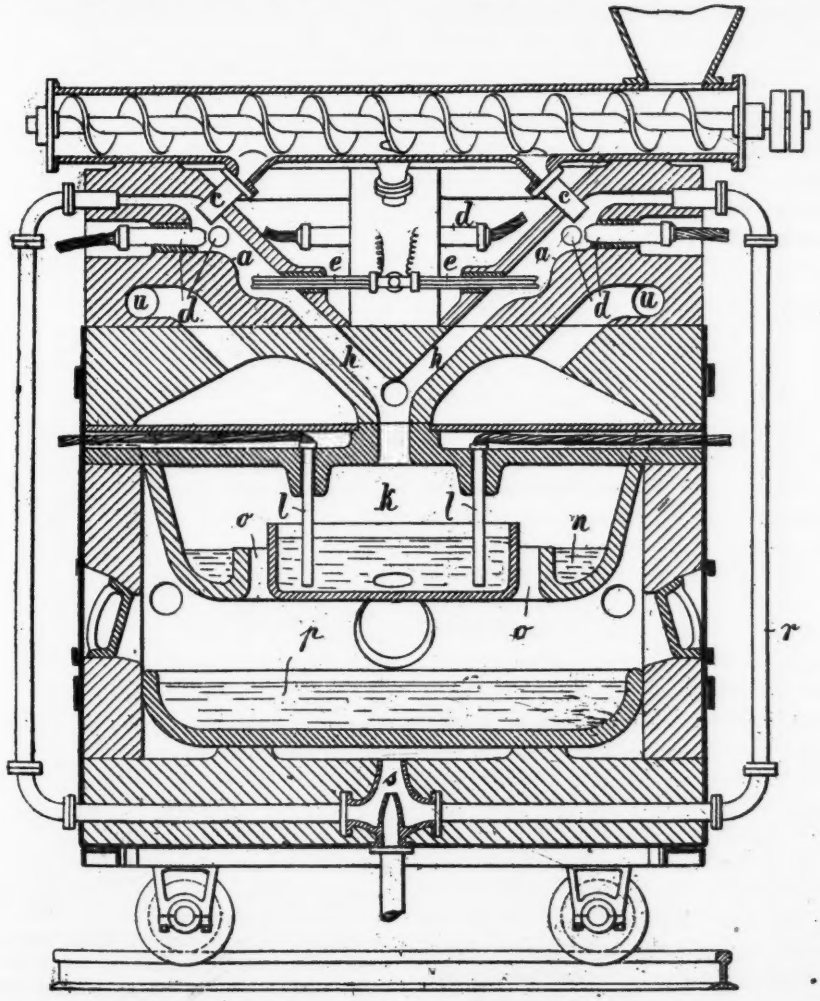


FIG. 6.—VOELKER'S IMPROVED FORM OF ELECTRIC GLASS FURNACE.

and electric glass manufacture has evidently been regarded by its directors as affording the means for utilizing the electric power and plant. The cost of the electrical horse-power-hour at the furnaces with the present generating plant is stated to be about 0.50 pfennig,[1] equal to £18 5s. per electrical horse-power-year. The new process for glass manufacture is therefore not too favorably situated, as regards cost of electric power.

The Electric Glassworks at Plettenberg on the Lenne, Westphalia.

The trials of electric furnaces for glass manufacture at this works were commenced in 1902, under an agreement between the Brussels company, L'Industrie Verriere et ses derives, which had purchased all the Becker and Voelker patents, and the Lenne Elektricitäts-u. Industriewerke.

The latter company had already developed 2,000 horse-power at Plettenberg (1,500 horse-power water and 500 horse-power steam), and it was arranged that portion of this power should be devoted to the manufacture of glass by the new method.

The trials at this place have been carried out with alternating current, and various types of electric furnace have been used. No details of the cost of power at the Lenne works are available, but it is stated that the kilogramme of glass can be produced here with the expenditure of only one and one-quarter to one and one-half electrical horse-power-hours, and that the quality of the glass is excellent.

Conclusions.

No details concerning the financial results of the industrial trials at Matrei or at Plettenberg have yet been published. Doubtless the inventors and their financial supporters convinced themselves

[1] *Zeits. f. Elektrochemie*, 1902, p. 243.

[1] *Zeits. f. Elektrochemie*, 1902, p. 421.

by the laboratory trials in Cologne in 1900 to 1901 that with electric power at a reasonable cost competition with the older process was possible. It is difficult to understand, however, why the industrial trials have been commenced under such unfavorable conditions as regards cost of power as at Matrei; and if a profit can be earned at this place, the new process of glass manufacture will evidently extend rapidly.

The following details from a recent article by Dr. Bermbach[1] concerning the coal consumption in the older types of furnace and the "estimated" consumption by the electric method will be of interest.

The regenerative gas furnace is calculated to have a heating efficiency of forty-two per cent, as compared with an efficiency of only eighteen per cent in the older form of direct-fired furnaces.

A very large proportion of the heat is, however, lost by radiation in the regenerative gas furnace, and Bermbach estimates that this loss amounts to between sixty per cent and seventy per cent of the heat liberated in the furnace. In the writer's opinion, this estimate is excessive. Using these figures as basis of his calculation, Bermbach has estimated that 1.5 kilogrammes of coal are required to produce one kilogramme of glass in a gas-fired furnace containing pots. With tank furnaces, gas-fired, the fuel consumption may fall as low as 0.50 kilogramme per kilogramme of glass; while with hand-fired pot furnaces, it may rise as high as four kilogrammes.

Bermbach then estimates the yield of electric glass furnaces, by assuming that the same heating efficiency will be attained in them as in carbide furnaces, namely, one of seventy to eighty per cent. Using the same figure for the heat calories necessary to produce one kilogramme of glass, as before (namely, 746), he calculates that 1,320 watt-hours will produce this amount of glass. If steam engines be employed to generate the electricity, using 0.80 kilogramme coal per horse-power-hour, the coal consumption per kilogramme of glass works out to 1.50 kilogrammes.

Bermbach admits that the clearing of the glass in the electrically heated furnace will require further heat; and this is undoubtedly the weak feature of all the electric furnace processes for producing glass. To maintain a bath or pot of molten glass at a red heat for twenty-four hours by resistance heating, means a very large expenditure of current; and it would seem probable that if electricity wins a permanent place in the glass industry, it will only be in conjunction with gas-firing for the clearing or refining operations.

The figure for coal consumption given above, show that the electric furnace methods of glass manufacture can not compete at present with the older method of manufacture by regenerative gas furnaces constructed on the tank principle; and their field of usefulness would therefore appear to be restricted to the production of the special varieties of glass, which at present are made in pot furnaces. For these special glasses, it is probable that the electric furnace method of production may offer numerous advantages; and possibly the very high range of temperature which can be attained by the electrical methods may lead to the discovery and manufacture of glasses with new and valuable properties. The recent production of vessels of quartz is an example of this use of the electric furnace.

Except in districts very favorably situated as regards the cost of developing water power, the new methods of glass manufacture are therefore likely to be restricted to these minor branches of the industry, and in the writer's opinion the bulk of the world's glass will still be produced for many years to come by the regenerative gas furnace invented half a century ago by Werner von Siemens.

[1] *Elektrochem. Zeit.*, September, 1901.

A New Method of Constructing Underground Conduit.

A demonstration was made recently at the Metropolitan power house, Neasden, England, of a new system of underground conduit construction. Iron pipes about four feet long are coated with a one to four mixture of paraffin and graphite, to the thickness of about a quarter of an inch. These were then screwed together to form one piece of any desired length, the joints being made by short sleeves screwed into the pipe, so that the exterior presents a smooth surface. The pipe, as thus arranged, is blocked up on wooden spacers, and then finally embedded in concrete. After the concrete has hardened, steam is passed through the pipes until the paraffin is melted and it is possible to withdraw the pipes, leaving the concrete coated with a mixture which acts as an excellent lubricant and enables the cables to be drawn in with ease and a minimum abrasion. The cost for this construction is given as from twenty-five to thirty cents per yard run of conduit. At the demonstration there was difficulty in withdrawing the pipes, as they cooled very rapidly after the steam had been cut off.

BOOK REVIEWS.

"Fowler's Mechanical Engineers' Pocketbook." 1904 Edition. Edited by William H. Fowler. Manchester, England. Scientific Publishing Company. Leatherette, red edges. Leather, gold edges. 440 pages. 4 by 6 inches. Numerous diagrams and tables. Supplied by the ELECTRICAL REVIEW at 50 cents or 85 cents, according to binding.

The 1904 edition of "Fowler's Mechanical Engineers' Pocketbook" has been issued. This useful little book is well known and contains a good deal of valuable information for the practical man. It is to be regretted, however, that the electrical section is somewhat deficient, containing only a list of the electrical units, a brief explanation of Ohm's law, and a word or two about electric cranes and the use of electricity in mines. At this day the mechanical engineer would be seriously handicapped if he had no other electrical information than is given here.

"Whittaker's Electrical Engineers' Pocketbook." Edited by Kenelm Edgcumbe. New York. The Macmillan Company. Leather. 456 pages. 4 by 6½ inches. 149 illustrations. Supplied by the ELECTRICAL REVIEW at $1.

This pocketbook differs from previous pocketbooks, as it does not merely give a number of formulæ, rules and data collected from various sources, but gives a kind of synopsis of each subject brought well up to date. Each section is prepared by a specialist in that line. Owing to the great specialization which the rapid growth of electrical engineering has necessitated, it is impossible for any one individual to keep pace with all the new methods and systems coming into use in other branches than his own. It is the aim of the present volume to furnish this information, for while the various sections give information quite sufficiently detailed for ordinary requirements, at the same time references are given to various recent papers and publications, where full treatment of the subject can be found. The book gives the usual mathematical and physical formulæ and tables. A chapter on practical mechanics; a discussion of electrical laws; methods of measuring and measuring instruments; electric lighting methods; dynamo-electric machinery, both alternating and direct; methods of testing; power transmission; electric traction; and central stations and accessory apparatus are all satisfactorily presented. The design of direct and alternating-current machinery is treated fully, and a chapter on electrochemistry describes certain of the processes now in wide use.

HARD DRAWN COPPER WIRE.[1]

BY FRANCIS W. JONES.

The great strength which is obtained in hard drawn copper wire (of over 60,000 pounds breaking strain to the square inch, which is very close to ordinary iron), with over six times better electrical conductivity than iron, with its almost complete immunity from oxidation and corrosion, ensuring a negligible depreciation, and its small electromagnetic inertia as compared with iron, are qualities which have made the use of copper wire very important to telegraph and telephone companies, and to meet the necessity of systems of communication requiring more rapid signals than Morse, the value of copper wire to telegraph companies for overhead construction will be still very greatly enhanced. But the full value of such wire, particularly its mechanical qualities, can only be secured by its most intelligent and careful construction and maintenance, from the fact that the strength of the wire lies entirely upon its surface, and that to secure the utmost tensile strength the wire has to be tempered to the verge of brittleness.

When telegraph wires were first strung upon poles, the length of the spans, the distance of wires apart, and the sags given, were decided purely by mechanical and financial considerations. The length of span having been fixed to require as few poles per mile as possible, the sag was restricted to such a distance that the wires would not swing together in the wind.

Modern construction has been determined largely by the same consideration.

An exception was made by the American Rapid Telegraph Company and the original Postal Telegraph Company, several years ago, in placing their wires farther apart to obviate the effects of electrostatic lateral induction, but on the discontinuance of the rapid systems then used by these companies, the intermediate space on the cross arms was used for other wires, and within recent years the tendency has been to place the wires still closer together, and this has become possible by reason of the shortening of the spans by a greater number of poles necessary to support the increasing load of wires.

Notice was early taken by engineers of the temperature effect upon wires, as it was found that when they were put up in a high temperature, with but little sag, that they would snap during cold weather, so the engineers furnished formula according to which sags should be given to wires of different lengths of span when erected at various degrees of temperature.

It is shown by Mr. John Gavey, the engineer-in-chief of the British Postal Telegraphs, page 336, vol. xxxi of the Journal of the Institution of Electrical Engineers, London, that a hard drawn copper wire, when under a very light stress, acquires a permanent set if the stress be maintained sufficiently long, and that a wire nearly No. 12 B. & S., with a breaking strain of 490 pounds, loaded with 110 pounds, recovered its original length upon removal of the load if it was not continued too long, but if the load was kept on for twenty-four hours a permanent elongation of one-sixty-fourths of an inch was produced in a length of about forty feet and that this elongation was a function of the time the load was kept on, increasing to one-thirty-second of an inch in three days and three-sixty-fourths of an inch in two weeks.

It is shown that hard drawn copper wire will not respond to its natural elasticity after being loaded for a few hours, and that the elasticity has been killed, so to speak, or the wire fatigued and its natural elasticity disappears.

I erected on May 7 last a new No. 9 B. & S. hard drawn copper wire, between fixed supports, 124 feet one inch apart, with a sag of four inches, which equaled a horizontal stress of about 231 pounds, or roughly one-third of the breaking strain of the wire. The temperature at the time was sixty-five degrees Fahrenheit. On July 10, temperature 102 degrees Fahrenheit, the sag was eleven and one-eighth inches, and later in the day, at ninety-three degrees Fahrenheit, the sag was nine and three-eighths inches. On August 6, at a temperature of sixty-five degrees Fahrenheit, the same as when the wire was erected, it showed a sag of nine inches, or five inches in excess of the sag that was given it when first put up.

A new hard drawn copper wire has a natural elasticity which permits it to elongate a very trifling amount (about one-tenth of one per cent), when under not exceeding two-thirds of its normal breaking strain for a short period of time, but when the strain upon the wire, or the period of time increases, then the wire permanently elongates.

When a short piece of the wire has been placed under stress to the limit of its breaking strain, of about 670 pounds, for a No. 9 B. & S. gauge, it breaks, and the two pieces measured will be found to have sustained a permanent elongation which, according to the temper of the wire, generally ranges between one and two per cent, and a piece of the wire, 150 feet long, when subjected to a strain of 670 pounds, at the same rate of elongation, would stretch from eighteen to thirty-six inches before breaking.

If such an elongation were possible to take place between telegraph poles, it would allow the wire a sag of nine feet or over.

Hard drawn copper may be permanently elongated nearly up to its maximum limit of elongation, and it will require as much strain to break such a piece of permanently elongated wire as if it had never been stretched.

What actually happens therefore seems to be this: Suppose a wire, when new, is given a sag of nearly seven and three-quarter inches, between poles 150 feet apart, at eighty degrees Fahrenheit, the wire then has a stress of about one-quarter of its breaking strain and the length of the wire is 150.0072 feet.

Should the temperature fall sufficiently, this wire will contract so that it will be subjected to a very heavy strain which will cause it to elongate unless the wire contains weak spots or kinks or places that have been slightly abraded or indented at the tie wires, in which case the wire will break at such weak points.

When this is the case the weak spots in the wire will, of course, prevent it from becoming permanently elongated beyond what it naturally elongates upon the poles as demonstrated by Mr. Gavey.

Should the wire have no unusual weak spots it will elongate sufficiently to prevent the stress in the wire raising to its breaking point.

It is evident that if linemen were to adopt the practice of taking up the sags by cutting out pieces of wire, that the time would soon arrive when the wire had stretched to the limits of its natural elongation and would break under the first stress imposed by low temperature or other cause.

[1] Abstract from *Telegraph Age*, November 1.

The Automobile Industry in Great Britain.

Mr. S. F. Edge, who is well posted in automobile matters, is authority for the statement that Great Britain is the largest market in the world for automobiles, and that the greater part of those in use there have been imported from the Continent. Last year 3,500 cars, to the value of $5,230,000, were imported, and this year the figures have risen to 5,330 cars, valued at $8,000,000. Mr. Edge points out that the raw material of the motor cars is of inconsiderable value, and that the greater part of the expense goes in wages. The British makers are sparing no effort to compete successfully with the foreign makers, and there are now in England a number of firms who are placing on the market cars of great practical utility and efficiency.

STATION ECONOMY AND MANAGEMENT.

A SYMPOSIUM OF IDEAS FROM PRACTICAL MEN.

At the recent meeting of the Ohio Electric Light Association, the question of station economy and practice was given considerable thought. The following communications are by the men who have had an active experience in this special field.

STEAM RECORDS.

BY GEORGE HAYLER, JR., VAN WERT GAS, ELECTRIC AND POWER COMPANY, VAN WERT, OHIO.

Every central station has some system of records, in some cases perhaps crude and in others extremely elaborate, yet serving each in its way to cover the daily operation of the plant, with the object in view of keeping track of the cost of production.

Much time and effort have been expended by the engineering departments of the larger electric companies in developing systems of records, covering the physical operation of their respective plants, and thanks to the interest displayed at electrical conventions by the various members and through the explanation of their views and methods these systems have become in a measure uniform, and it is altogether likely that they will be found pretty much the same among the larger stations all over the United States. It is entirely due to the intelligent study of these records and the application of the knowledge derived therefrom that the cost of producing electric energy has reached the almost incredibly low figure quoted by some of the larger central stations.

With the smaller companies, however, this is different, and among the personnel of the average station the question of keeping records is the least of their troubles. This is not as it should be, and although it is impractical and perhaps utterly useless to attempt to keep an elaborate system of station records in a small plant, yet there are some items of expense which must be kept closely in mind, and to do this intelligently a systematic and accurate record of each day's operation must be made.

The cost of operating a steam plant may be roughly divided as follows:

Fuel.
Labor.
Water.
Oil and Waste.
Repairs.
Sundries.

Of all these items fuel is perhaps the greatest and receives the least attention. The management of a small station is usually niggardly in the matter of wages, and a five-dollar raise in the salary of a fireman is an event of some importance and worthy of the attention of the board of directors; yet this same man handles coal monthly perhaps to the value of from five to ten times his salary, and five dollars worth more or less would be something too trivial to take notice of and in most stations impossible of detection.

The amount of money expended for fuel each month is dependent upon a number of considerations, and in order that a close check may be kept on this one great item of the cost of production, a system of records, consistent with the size of the steam plant, should be maintained.

The efficiency of the steam engine depends very largely upon its proper adjustment for the work to be performed and the steadiness with which it is supplied with dry steam. Indicator cards should be taken from time to time, to make certain that the valves are tight and properly adjusted. This is a comparatively simple matter and will often bring to light the cause for an excessive use of steam. Of course in large plants this is done periodically, but many smaller stations never owned an indicator, and would not know how to use it if they had it.

A record should be kept of the steam pressures, either with a recording steam gauge or by entries on the daily log. It is well to have several gauges located in different parts of the plant, so that they may be easily seen by both the engineers and firemen. The steam pressure should be varied according to the load on the engine. This is especially true in small plants, where it is impossible to divide the load among a number of units.

Records should be made of the time of stopping and starting engines; the number of hours run by each and these figures compared with the electric load curve for the same period of time. It will be found perhaps that too many engines are being run for the work performed, and every hour an engine runs unnecessarily is so much loss.

By a little study of the load curves it will perhaps be found that on certain nights the load is greater, and these changes will happen almost periodically for months at a time. If the engineering force is advised of this so that they may know what to expect in the way of a load, it will save firing boilers unnecessarily and leave engines standing idle that might otherwise be put into service when not needed. I have noticed in some large isolated plants large blackboards in the engine room on which are posted each day an extra lighting that will have to be taken care of. This is a great help, and will save money and annoying temporary overloads.

Boiler efficiency is influenced by a multitude of conditions, and it is here that the most serious leakage in the express account is to be met with. The most serious sources of waste in the fire room are:

Improper methods of firing.
Firing too many boilers for the load.
Coal that is too expensive for the work demanded from it.
Dirty boilers.
Cold feed water.
Leaks.

The average fireman has two objects in view; one to keep a sufficient head of steam, and the other to keep plenty of water in his gauge glasses. The idea that he is burning money, and lots of it, never enters his mind. He does his work in the easiest way possible, and the company pays the bills.

There are as many different ways of firing as there are firemen, but there is only one way suited to each individual steam plant. Some of the larger stations keep track of the individual performance of their firemen by the aid of various records and devices, and among the latter a system of testing the composition of flue gases from each boiler breeching is both interesting and valuable, and, where the expense will warrant its use, an almost certain method of detecting waste. It is impractical, however, for small plants, and the only recourse is by a study of records, to determine on the best method of handling the grade of coal being used, and then instructing the firemen accordingly.

In a lighting plant where the load is likely to vary rapidly there is a tendency to keep more boilers in service than are necessary. This is largely due to an effort on the part of the firemen to make their work an easy task, and the result is that for a large share of the time the grates are bare and a considerable column of air simply passes through the furnace and flues absorbing heat and wasting fuel at a tremendous rate. This is something which should be watched carefully, and it can only be done by keeping a record of the boilers in service, the hours run by each and then making an intelligent comparison with the station load curve for the same period.

Burning coal of a grade too good for the work demanded of it is another source of waste. The cheapest coal is the one which supplies the greatest amount of heat

units for the least amount of money, and not the one that will make the least amount of work for the firemen. Coal should be tested to discover which grades are cheaper. Because one station burns a certain grade of coal economically is no reason why the same should hold good in another plant operating under different conditions. The cost of coal depends largely on the freight rate, and since it costs no more to haul a ton of good coal than a ton of slack, there may be a dividing line beyond which it would pay to use the better grades although they cost more money per ton. There is only one way of determining this, however, and it is to make careful comparison of the amount of work done by each coal in a specified time. The chances are that the engineering force will be prejudiced against the use of cheaper grades of fuel, but it is not wise to rely too much on their opinion of the heating value of a coal.

Coal should be weighed by each fireman on his run. Water should also be measured by a meter. These records should be compared, and while the results will only approximate the evaporation, they will serve as a check, and if one fireman is evaporating more water than another for a like amount of coal there is something wrong.

Boilers should be washed periodically, flues cleaned, dust removed from combustion chamber, and a record made of same both on the daily log and by chalking the date on the boiler front.

Feed-water temperatures should be kept daily and any undue variation investigated at once.

Coal can be easily weighed even in the smallest station, and if it is not done every day, it can be done for several days at a time each month and an idea thus obtained as to what is being done in the fireroom.

Water can be measured conveniently by a meter adjusted for the average temperature of the feed water. The meter can be easily checked from time to time by the aid of an ordinary barrel and a pair of scales, and a correction made for any constant error.

The number of boilers should be carefully proportioned to the load, and only enough kept in service to permit the firemen to maintain a proper head of steam by the exercise of care and attention in keeping his fires as they should be. This will prevent careless firing, and the consequent use of much unnecessary coal, both during the run and in heating up useless furnaces and boiler shells.

The problem of evenly dividing the labor of operating a station among one's engineering force is one that requires a good deal of thought and diplomacy in solving. It will be simplified greatly, however, if there are at hand records showing the number of hours worked by each man, the amount of coal handled during that period, the load on the station, etc. Men get jealous of each other, and each thinks the other has the easiest time of it. A few cold figures will do more to dispel ideas of mistreatment from their minds than whole days of arguing.

Oil and waste are no very important items in the expense account, but all the oil which is used goes somewhere, most likely onto the floor and belts, and it is well to cut the quantity used as much as is possible. Just why one man needs twice the oil to do the same amount of work as another is a problem, but the trouble can perhaps be located by a careful study of the daily record. A good oil filter is an excellent investment. When I say a good one, I mean one that will do something more than strain out flies and bugs. It is surprising how the oil consumption will decrease when men find that they are being watched, and with how much more care they will save oil that has been used if they have some device for putting it into shape where it can be safely used again without danger of stopping cups and oil guides.

Packing is another small item, but when engines and pumps have to be packed too often, something is wrong. It may be the packing and it may be something else. A record will help very materially in deciding just what is best to buy.

Repairs is an item which must not be overlooked, and when repair bills on a piece of machinery commence to assume too large proportions it is well to consider something new.

To sum up; I would suggest that for a small or medium-sized plant a daily record be made up as follows:

The names of engineers and firemen on duty, the hours worked by each.

Readings of the switchboard instruments, giving approximately the load in kilowatts each hour from which a load curve may be plotted.

The number of boilers in service, and the hours run by each.

The number of engines in service, and the hours run.

The amount of coal burned by each fireman or group of firemen during a stated period. Total coal burned in twenty-four hours.

The amount of water pumped into the boilers during the same time.

The approximate evaporation figured from this data.

Steam pressure at stated intervals.

Temperature of feed water.

Temperature and weather.

Amount of cylinder oil used by each engineer.

Amount of engine oil used by each engineer.

Amount of waste and packing.

Some space should be left on report sheet for "remarks"—records of trouble and such other items as might suggest themselves from time to time.

It is very little trouble for the station force to keep a systematic record of this kind. It serves a useful purpose in that to get the data required periodical inspections must be made of one thing and another, and the engineer and firemen thus often notice things that might otherwise be neglected. A careful study of the daily sheets will prove productive of many ideas for betterment, and they are always a valuable record to look back to for the thousand and one little things that one wishes to know concerning the operation concerning the station.

DEVELOPMENT IN THE ENGINE ROOM.

BY J. H. PERKINS, YOUNGSTOWN CONSOLIDATED GAS AND ELECTRIC COMPANY, YOUNGSTOWN, OHIO.

This brief outline of our efforts toward more reliable and more economical operation is not given as showing methods which will apply to all plants, but rather to show what has been accomplished, and to create a discussion whereby we may derive some benefit. I also realize that some of these features are a matter of history to some of the larger companies, but the Youngstown plant being of average size may serve the purpose referred to.

Our present engine room equipment consists of one 350, one 400, two 600 and one 1,000-kilowatt, 2,200-volt, sixty-cycle, two-phase, direct-connected units; four being operated by horizontal, cross-compound, non-condensing engines, and one by a vertical compound engine.

These units are furnished exciting current by two thirty-seven and one-half kilowatt and one seventy-five-kilowatt, 125-volt, engine-type generators, direct-connected to Westinghouse compound engines; two seventy-five-kilowatt, 550-volt, rotary transformers for direct-current motor service.

We have discarded all belt machines and all generators of any kind other than the two-phase alternating-current type.

The remaining commercial series, arc light machines have been thrown out and

constant potential alternating-current arc lamps on meter take the place of the series lamps.

The direct-current series, open-arc street-lighting machines have been replaced by constant-current alternating apparatus.

All possible direct-current power service has been changed by the use of single and two-phase motors, the remaining 500-volt, direct-current service being furnished by rotary transformers that the prime movers may all be of the same type.

The switchboard has seen many changes, but more in the way of detail. All open-type knife or plug switches on high potential have been replaced by oil switches. All fuses on exciters and generators are being discarded. The lighting circuits are being provided with circuit-breakers, and the alternating-current side of railway circuits with fuses.

Recording wattmeters have been provided for all of the generators in addition to those already on the different kinds of service.

Power-factor meters have been added to the generator panels in order that there may be as little cross current as possible between generators running in parallel, and that we may know the character of our load, not only of different kinds, but at different times of the day.

A voltage regulator has been added for reasons as stated later, and although this is not in actual operation, we are expecting good results.

All machines are provided with oil from a gravity feed and pump-return oiling system, and oil cups are not used except where absolutely necessary. This has resulted in more satisfactory oiling at a considerable saving.

Monthly indicator cards are taken of all engines, and cards filed for record, it being our intention to stop any irregularities as soon as possible after they occur.

One of the first difficulties which faced us in this change was parallel operation of the units on alternating current.

As indicated in a previous paper, we had no trouble with belted machines, but considerable trouble with the first direct-connected machine; not when operating with the belted units, but in trying to operate rotary transformers or in trying to operate in parallel with the next direct-connected machine.

We found that the trouble did not lie in the flywheel nor in the variation of effect in the up-and-down stroke of this engine, contrary to our opinion at that time. A good share of the trouble was found in the rotary transformer, and we also found a dash-pot on the governor of the engine was a cure for almost any trouble in parallel operation. The trouble in the rotaries was easily remedied. All of our engines have been equipped with dash-pots on the governors, and we have no trouble as long as these are in good condition. Any engine in the plant will pump and cause all kinds of disturbance if the dash-pots are out of order, and some of them would not work an instant in parallel without a dash-pot. We think it would be very much more difficult to get the same results by the use of heavier flywheels.

In the matter of engine regulation, we have decided on about three per cent as the best that can be had, and have good, reliable, parallel operation. Some of the manufacturers say that this should be fully four per cent, but you may make it as fine as you please so long as you are able to take all the kinks out of the governor by dash-pots or otherwise, in order to cause smooth rotation or regular angular velocity.

In the changes referred to we have taken a backward step in only one feature, "voltage regulation," and this seems unavoidable and was anticipated. The main cause has been the greater increase of railway load as compared with lighting. With fifty per cent lighting and fifty per cent railway the service will be entirely satisfactory when operated from the same machines; but if railway load is added in greater proportions the effect will become noticeable, especially if the machines are overloaded. To overcome this, at times when it seems desirable to operate both light and power together, we are installing a voltage regulator of the latest type.

It is safe to say, however, that we at all times get a regulation which should be impossible under the same conditions of load and manner of running on any other systems, except by the use of a storage battery of ample size.

During the time referred to, in this change, 1900, to date, the lighting output has increased 142 per cent. The railway output about 800 per cent. The power-motor output about 200 per cent, and the total output about 440 per cent. Our load-factor has increased from about twenty-five per cent to fifty per cent, and when you consider the earning power of these two conditions it is marvelous.

We have not had a single shutdown, due to the engine room.

The economy in the engine room has increased to a wonderful degree, not only by improving the load curve and by reason of the large output, but by reason of the change in the type of apparatus.

The greater part of the saving has been made in labor and maintenance charges, and we expect to improve further on steam economy.

For an increase of 225 per cent in capacity, we have increased the engine room labor required only fifty-seven per cent. There has been a decided saving in maintenance of electrical apparatus, this account having dropped to almost nothing.

THE VALUE OF STATION RECORDS.

BY A. C. BLINN, SANDUSKY.

It is not the purpose of this paper to go into the details of forms and systems of station records, but to more fully demonstrate (especially to the managers of small stations) the value and vast importance of carefully keeping station statistics. I do not believe that too much weight can be attached to the value of a complete record of each twenty-four hours' operation of your station, regardless of how small it may be. The size of the plant should not enter into the question, as these reports are as valuable to one as to another. To the managers of large central stations, the value of carefully making station records for immediate use, and filing them for future use, is very evident and is demonstrated by the fact that as a rule in stations of even moderate size this work is given very careful attention and it has grown to be an important factor in the skilful operation of modern plants. The attitude of managers of small central stations toward the installation of a station record system is perhaps more or less adverse owing to the fact that the opinion prevails that an enormous amount of red tape will be required, from which little or no benefit will be derived. What station manager is so proficient as to be able to estimate the worth of a system of this kind, especially when it has not been in use? Occasionally we hear the remark, that it will make more work for station employés, and make them dissatisfied, etc. This is decidedly the wrong opinion for several reasons, first, because a certain amount of system is good for any employé; further, an employé who is energetic and ambitious, and who will carefully study station records from day to day, will not only benefit himself but also his employers, and that to a very large degree. It must be understood that this paper refers to complete records and not to mere notes showing output in amperes every hour, and at what time arc circuits and machines were started, etc. The station manager or su-

perintendent who carefully examines his station records each day, will become exceedingly familiar with the detailed operation of his plant. It is probably the only way in which to work intelligently toward broadening the peak; little loop holes in the consumption of coal, oil and other manufacturing supplies can be discovered, where small economies can be practised, which at the end of the year will make a very material showing in our balance-sheet. The managers of large stations have realized this fact for several years, and while the practice of carefully keeping station records is becoming more general with the managers of small stations, the system has not reached that point of perfection that it should. In a measure this can be accounted for by the opinion "that our station is not large enough" or "our output is too small" or "that we can not have so much system," etc. These and many other excuses are insignificant compared to the value received, not only in a financial way but in the matter of service to consumers, which is a vital point recognized by all. Let us view this matter from another standpoint, let us assume that your company has opened negotiations for the sale of its property, the prospective buyer ordinarily will send his engineer to make a report on the condition of affairs as he finds them. After examining the ledger accounts and the physical condition of the plant he will naturally ask to see your station records for as long a period as possible, and if your plant has had a normal growth and been properly managed, these records will be of great value, not only to the company but in estimating the ability of the manager. On the other hand, if the records are lacking, the prospective buyer will at once underestimate the value of the plant, but will probably not underestimate the value of the manager, and he will have good grounds upon which to base his conclusion. One of the greatest difficulties experienced in the installation of a thorough system of this kind lies in the fact that employés to whom the keeping of these records is assigned will, without close attention, become careless, which is probably caused by the fact that they are not able to fully understand and appreciate the value of such reports. It is utterly useless to inaugurate a system of this kind and not have it kept up as carefully one day as the next. After an employé once oversteps the line without a reprimand, and a severe one, his value so far as keeping station records is concerned is reduced fifty per cent. Employés should be educated if necessary and made to understand that the manager depends on the station records, and must have them accurately kept. They should be taught to understand that the keeping of station records is as important as keeping the general books, which is indeed the case. From the station records we determine our loss from generator to consumer, which is a highly important point that should be carefully watched by every manager of electrical properties. Without the record we are in the dark absolutely as to what we are doing. You may say to your engineer that he has used more coal this month than during the same period last year; invariably his reply will be that the load has been greater. Without a station record it is hardly possible to refute his argument, and the same rule applies to other branches of the manufacturing department. In this department our cost originates, and here is where we should apply economy in every sense of the word, which is not possible without complete knowledge, and such knowledge can not be had without complete station records. The cost of the installation of a complete system is not large and when compared to the benefits derived is, practically speaking, much less than nothing; these benefits, of course, can only be determined by practice, and it is a matter that rests entirely with the manager as to whether he will, or will not, be benefited. It must not be expected that any great value can be derived from station records if they are not watched from day to day and comparisons made with the work done, one, two or three years previous, when you are able to make such comparisons you will find them intensely interesting and a great help in future additions and betterments.

ENGINE ECONOMY AND EQUIPMENT.

BY E. J. BECHTEL, TOLEDO RAILWAYS COMPANY, TOLEDO, OHIO.

Steam engineering dates back into ancient history, but for the purpose of discussion before this convention the early records or data are of very little value.

The earliest steam engine was of the turbine type, but was not used extensively, being displaced by the reciprocating engine, which has had almost a clear field until the present time, and upon which many important changes have been made, especially in the valve gear, governing mechanism, etc., to bring it up to the present standard of efficiency. These changes, however, have had a tendency to complicate the mechanism, making constant expert attention essential.

At present there are two or three types of steam turbines on the American market which appear to be very attractive from a central station standpoint, from the fact that they give at least as good economy, are much more simple, require less attendance and maintenance and occupy a very much smaller space than any type of reciprocating engine of the same capacity; and last, but not least, they can be purchased at a less first cost. The high speeds of these turbines have limited their capacity to 500 kilowatts per unit for direct current, but can be built for almost any capacity for alternating current.

Gas engines have only had a place of minor importance, being handicapped on account of size, unreliability and other conditions, which make them undesirable as a commercial product. However, improvements have also been made in the gas engine, and it is hard to predict what the future will bring forth in the line of gas engines and gas turbines. Gas engines are at present in use up to 2,000 horse-power, for purposes other than central station work, but under circumstances favorable to them, which do not represent ordinary commercial conditions.

In designing the engine equipment for a central station all sides of the problem must be considered. It is neither the engine having the best steam economy on the one extreme, nor the engine having the least first cost on the other extreme, which is to be considered the most efficient; but it is the engine which is best adapted to operate under local conditions as they exist, or under conditions which can be brought about. In other words, all conditions, including interest on investment, etc., should be carefully studied before deciding upon the proper equipment, as upon the combination of all conditions depends the advisability of using high-pressure steam, superheated steam, vertical or horizontal, simple or compound, condensing or non-condensing, high or low-speed engines, size of units, with or without steam jackets, reheating coils, superheaters and various other appliances which tend to change the conditions of economy.

The economy of the central station does not depend entirely upon the design of the equipment, but also upon the operating force, which can in a great many cases lessen the efficiency of a well-designed station, or increase the efficiency of a poorly designed one by their method of operation. Thus the importance of carefully selecting an operating force which will give maximum results with the

least cost is apparent. The force should be carefully made up of men capable of promotion with the knowledge that a defined line of promotion is before them, depending upon their ability and time of service, without any show of favoritism. In this way only will we be able to get the proper grade of help to begin at the bottom and at a salary in proportion to the position.

ELECTRICAL DISTRIBUTION IN THE ENGINE ROOM.

BY W. F. RABER, MANSFIELD ELECTRIC LIGHT AND POWER COMPANY, MANSFIELD, OHIO.

In a small plant like our own where it is desired to furnish several different classes of service from the same prime movers the distribution of your generating units and the arrangement of your switchboard, so you can cut in and out the various machines and circuits in accordance with the demand upon the plant, means no small amount of manipulation, especially where the units are all small, as is mostly the case, and where the capacity of your plant can only be increased out of the earnings of the plant, and where this is not possible the superintendent or manager is obliged to accept appropriations dealt out to him in "homeopathic doses."

In the earlier days of the business when direct-connected units, yes, even direct-belted units, came in "large packages" for the average central station, we were obliged to fall back on the line shaft and counter shaft to properly distribute the equipment so as to give the maximum power with the greatest flexibility possible, the latter being the most important of the two. While we admit that this only increased one feature of your plant at the expense of another.

The company with which I am connected has gone through a number of these distressing changes, each time to find our apparatus loaded beyond the limit on both our light and power circuits. As a matter of history I might add that we were the first combined light and railway plant in the state.

Only a few years ago we found it necessary to install a new engine to accommodate the usual increase in our light department, as well as supply power to an interurban railway operating four large, high-speed cars. To utilize our old generators of both direct current and alternating current and by adding one of each we found by properly distributing them we could take care of all classes of service with an equal amount of reserve and without going to the expense of duplicating our plant throughout.

Our outfit now consists of three engines, four direct-current, one two-phase and two single-phase generators. To carry our maximum load would require two direct-current and two alternating-current machines, leaving one of each for reserve. Without going into details, these machines with one exception were belted to a single shaft, with clutch and quill pulleys driven by two of the largest engines belted to the same shaft. By a special combination of quill and clutch pulleys we could operate either or both engines on any or all generators.

To take care of the fluctuations in speed of engines due to heavy pull on street railway or power circuit, we installed on each of the single-phase machines a Chapman voltage regulator. These regulators regulate very closely, and for conditions similar to ours too much can not be said in behalf of this part of the installation. Of course, there is a slight change in the periodicity of the alternating-current machines due to rise and fall of the speed of the engine, but not enough to seriously affect the operation of small induction motors and multiple arc lamps.

This method of distribution we do not attempt to hold up to you as the ideal one from an economical standpoint. But with the multiplicity of units which we had and the classes of service we were called upon to give, flexibility and reliability of the service were of the greatest importance in our case.

It is of equal importance to have your switchboard as simple and flexible as possible where you depend upon the regular engineer to do his own switching. In order to keep the engineer from throwing the machines together and burning up everything on the board except the toggle bolts that hold it to the wall, we designed a board so that any of our station attendants could operate it with perfect safety.

Our direct-current board is equipped with a double set of bus-rods and with double-throw switches with an individual circuit-breaker on each outgoing circuit and on each generator in the usual manner.

For our alternating-current board we have four pairs of bus-rods, one for each machine. For each outgoing circuit we have a special revolving four-pole switch which makes it impossible for the operator to throw any two machines together, thus avoiding a great deal of trouble that we used to experience on our old layout.

One who has been connected with the light and power business for ten or fifteen years can see very little of a permanent nature in the engine room, especially in the electrical equipment. Even to the present day we speculate as to the time when the steam turbine outfit will supplant the present direct-connected units.

After summing up the business for another year we find ourselves again confronted with applications for power at a low rate, and it is up to us to serve them at a small profit or open the field and invite competition.

In order to settle the question of municipal ownership for the next ten years we, for the first time in the history of the company, bid on the city lighting and were successful, for which provision must be made in our engine room for another class of service after April 1, 1904.

We have now gone the limit on small machines and we feel we can, by the proper distribution of new generators, serve all classes of customers, including our new city contract, without the use of any shafting and only a minimum amount of belting.

We propose to install a three-phase generator of proper size, direct-belted to each of our Corliss engines, and take from these power for all classes of lighting and small power motors, and install rotary converters for our direct-current power customers and for railway purposes. Also to install a storage battery to float on the railway and power circuits, thus work our engines at an economical point, and depend upon the battery to take care of the peak loads and the fluctuations in speed of our engines, eliminating the use of separate regulators on our lighting circuits.

This far we can go with our present engines, but we must also provide reserve capacity, which we propose to do by installing a steam turbine of ample capacity. It is intended to run this turbine regularly and use our engines for reserve, and, when necessary, to carry the heavy winter peaks on the light circuits.

London Municipal Telephones.

After an expensive battle with the National Telephone Company, the Hull (England) corporation has obtained a victory on the municipal telephone question. The Local Government Board has sanctioned a loan of £43,000 for starting the municipal scheme. The scheme originated about three years ago, and over 1,000 subscribers have promised support.

From the London Electrical Times.

"Our New York contemporary the ELECTRICAL REVIEW has, without a word of warning, changed its type and turn-out in the middle of a half-yearly volume. With one exception the old was well enough, but with no exception the new is rather better. The exception was some index of contents which has long been a needed addition, and is now supplied."

ELECTRICAL MINING NOTES.

THE AUTUMN MEETING OF THE INSTITUTION OF MINING ENGINEERS.

(Concluded.)

BY SYDNEY F. WALKER.

Another paper in which the inevitable electricity came up, and where one would hardly have expected to have found it, was in that by Mr. Francis Fox, brother of Sir Douglas Fox, past president of the Institution of Civil Engineers, describing some tunneling which had been done under his supervision in the Simplon. The tunnel will be twelve and one-quarter miles in length, and will be made at about double the speed at which the St. Gothard was made. The tunnel has been made largely with a modification of the Greathead shield which was so successful in the London "Tubes;" the modification consisting of the doing away with handling of the material at the face at all. The clay, for which the machine is used, is cut by a series of knives carried by revolving arms, which project in front of the shield, and are, in the machine employed, driven by an electric motor. The dirt which is cut away falls to the bottom of the cut, and is picked up by revolving buckets, also worked by an electric motor, and delivered at the top of the shield to a conveyor, again driven by an electric motor, by which it is carried some twenty-five feet behind the shield. The introduction of the new arrangement with its electric driving has reduced the time of cutting and fixing a ring of iron twenty inches deep, in the direction in which the tunnel is progressing, from two and one-half hours to one hour, and the labor required from thirteen men to eight. Mr. Fox stated that his great object in bringing the matter before the Institution was to call attention to the Brandt hydraulic drill, which he stated worked without making the fine dust which is so dangerous to the health of the miners employed. With the ordinary rock drill, working in the strata usually met with, the atmosphere in the neighborhood of the drill is filled with very fine particles of razor-like dust, which if inhaled brings on miner's phthisis.

A paper by the present writer on "Alternating Currents and Their Possible Application to Mining Operations"—Part 2, "How Alternating Current May Be Used in Mining Work"—was a continuation of a paper read before the Institution three years since, and a further continuation of an earlier paper read before the North of England Institution, the parent of the Institution of Mining Engineers, in the year 1884.

The present writer's experience, which extends over nearly thirty years, in connection with colliery working is that simplicity is one of the essentials of success. Another point that was made was in connection with the starting and stopping of induction motors, and their behavior when overloaded. One speaker, a colliery manager, complained that he was obliged to have a very much more powerful engine driving his three-phase generator than would otherwise be necessary in order to provide for the starting current. He had a 100-horse-power genator and a 100-horse-power induction motor, but it took 185 indicated horse-power to start the motor, and he wanted to know if this was right. He had no starting resistance. The writer's view of the matter is that it was a very wise provision, however arrived at, his having about twice the power in his engine that he needed in his motor. Another of the points which in the writer's experience goes to ensure success at collieries, is the presence of plenty of power, and plenty of strength everywhere The engine may not work quite so efficiently in the sense that it will use a little more steam, but it will act very much more efficiently in keeping things going without breakdown, and in keeping the repairs bill low. After all efficiency should be measured, not by the steam taken, but by the actual running cost. There was also some discussion as to what current should be taken by an induction motor on starting, and at what overload it should come to rest, and if it was really a benefit its doing so. The writer's opinion is that starting current is purely a matter of construction, in the motor and its accessories, within certain limits. You must have a certain starting current, the latest claimed by the makers is one and one-quarter full load, and it may go up to almost what you like, if you do not employ any devices for reducing it. The action is very largely like that with a shunt-wound motor. If the starting current is too large you can not start at all, because you have neutralized the magnetic field on which you are depending for starting, but short of this you may have almost any value down to the minimum. The question of at what overload the motor comes to rest appears also to the writer to be one of construction. But there is this very important feature in connection with the question, the rotor will come to rest at some percentage of overload, whatever the construction may be, and the rotor, the secondary of the transformer which the induction motor forms, will not burn, though the insulation of the field coils, the coils of the stator, the primary, may burn. But this means that a three-phase motor will go on working under conditions where a continuous-current motor would have had to go to the repairing shop. If, say, a disc coal-cutting machine meets with a heavy overload, as when the coal comes down on to the disc, or when it meets with a ball of iron pyrites—the present writer has met with a case where a coal-cutting machine was taking 100 horse-power under such conditions—if the motor is using continuous currents the armature coils are burnt up almost of necessity, unless a base or cutout relieves in time, and work has to cease till a spare armature is put in. With three-phase induction motors, under similar conditions, the rotor would come to rest, and in the great majority of cases would be unharmed, while the coils of the stator, if the fuse did not blow, would have their insulation singed. But every one with any practical experience in running dynamos and motors will know that a machine will run a long time, and with perfect safety, with its magnet coils very much singed. The carbon that is formed in the extreme case is itself not a bad insulator for the pressure between coil and coil. And so the result is that when the obstruction is removed the motor can go on again, the only time lost being that taken in clearing the coal or the ball of pyrites. Discussion also took place on the question of varying speeds of induction motors. This of course is one of the points that has to be worked out, but the induction motor is no worse off than the continuous-current motor, in this matter.

The other paper on electricity was by Mr. W. Walker, who is manager of one of the Digby Colliery Company's pits in Nottinghamshire, on "Electric Coal-Cutting." The paper was a most important one, inasmuch as for the first time a colliery manager came out into the open and told his actual experiences with coal-cutting machines, and it led to other important results, as other colliery managers were induced to come out also and give their experiences. As a rule, it is difficult to get colliery managers to state their experiences, and it need hardly be said that they are of more value than the statements of the makers of the apparatus. Also the paper was unique in that for the first time in the present writer's experience, in England, a few colliery managers openly avowed a preference for the bar coal-cutting machines.

The bar machine ought to be the best, especially for use with electric motors. It runs at from 300 to 500 revolutions per minute and can therefore be connected directly to the motor, or, at the worst, requires only a slight reducing gear, an enormous advantage over the disc machines which run at from twenty to seventy revolutions per minute. The bar also can be made to avoid many of the difficulties which the disc has to face. It will work round a nodule of pyrites, where the disc has to go through it, or pull it out. Also there is no large surface for the coal to jam as there is with the disc, if it settles down. In spite of this, the bar has not found favor. At Digby, however, it is pronounced to be the only machine which answered their purpose in a certain seam, after they had tried two disc machines. The troubles which had been met with in the bar machines, from the teeth of the gearing breaking, appear to have been completely overcome. The trouble is stated to have arisen through the use of a series-wound motor. The bar would be cutting easily in comparatively soft material, and would be brought up suddenly by coming to some hard stuff, then, on passing through the hard stuff, would race violently, the speed of the gear wheels rising instantly from 1,200 feet per minute to 3,000 feet, and this naturally led to breakages of the teeth. The series-wound motor has been replaced by a shunt-wound motor, and these troubles, it is stated, have ceased. Probably a better understanding of the machine by its makers has led to the usual results—better construction, and better arrangement all around. It should perhaps be mentioned that the Hurd machine, made by Messrs. Mavor & Coulson, of Glasgow, is the only surviving bar coal-cutting machine at present. There are a few Golden machines still at work in Staffordshire and Durham, but only the Hurd is now manufactured. An important fact which the author of the paper brought out was the use of a parallel-bar, instead of a taper bar, reducing the power taken by the machine from 7.77 horse-power per square foot of area holed to 4.66 horse-power. This result, however, was questioned by another colliery manager who was also using the Hurd coal-cutting machine. Mr. Laverick, manager of Wollaton colliery, Nottinghamshire, stated that he used the parallel bar because he found a tendency with the taper bar to climb up into the coal, instead of keeping to one line. He finds that the taper bar running in the same direction with the machine climbs, while the parallel bar running in the opposite direction tends to run downward more into the dirt underlying the coal, but the parallel bar takes as much power as the other. It makes a considerable difference, as will easily be understood, to the value of the coal produced, if the cut is made in the dirt, clay, etc., underlying the coal, and not in the coal itself. Mr. Laverick also asked why the author of the paper only used a four-foot bar. Mr. Leverick used a five-foot six-inch bar, and found that it worked quite satisfactorily. The disc machines, it will be remembered, rarely make less than a five-foot cut, in Yorkshire, where they are most employed. In Scotland a three-foot and a three-foot six-inch cut are common. Mr. Laverick also stated that a Jeffrey heading machine which cost only £300 saved £200 per annum. Another point that was brought out in the paper, and in the discussion, was the fact that, according to the author of the paper and to some of the speakers, the saving in the amount of small coal which had been claimed as one of the principal advantages of machine holing, was not realized in the majority of cases because the coal had to be broken up by the pick after it had come down, in order to load it into the mine wagons; and in breaking it up considerable spall was made. The feeling among the speakers appeared to be that only from three per cent to ten per cent less slack, small coal, was obtained with machine cutting than with hand cutting—as much as thirty per cent less has been claimed. Another point upon which considerable discussion ensued and upon which considerable surprise was felt at the statements in the paper, was the number of men it was necessary to employ with the machine. With the disc machines, of all kinds, three men may be taken as the standard, one controlling the machine, whether the power be compressed air or electricity; one in front of the machine, seeing the rails placed ready for it to run on, and one behind the machine, seeing that the dirt is taken out, and passing the rails over the top of the machine to the man in front. The usual practice also with nearly every machine using rails, is to have three pairs of rails, one pair actually under the machine, one pair in front, and one pair behind. With some machines it is stated that two men only have succeeded in running, and with others four men have been necessary, but three may be taken as the average. The author of the paper found it necessary to employ six men; two road layers, one driver, one shoveling out dirt at the sleeve, one timbering and spragging, and one cleaning out the holing dirt. In addition to these, the author stated that with one machine tried, there was an electrician, and frequently his assistant. It may safely be prophesied that if this is the best that can be done with coal-cutting machines they will not easily supersede hand holing. One of the most important points in connection with coal-cutting machines is the fact that less men can be employed. Where collieries are situated in out-of-the-way places, the question of housing the colliers is often a very serious one. Large numbers of houses have to be built, and one colliery manager in the county of Durham told the writer last autumn that one of the reasons for his firm taking up coal-cutting machines was this fact, that they would have to build so many more houses if they did not.

The inevitable question of cables came up, and different colliery managers detailed their experiences. One interesting case was given where the cables were enclosed in lengths of iron pipes, in the shaft, and the pipes filled with pitch. The cables had been in several years and had given no trouble. Another point should be mentioned which came up in Mr. Walker's papers, as it is of some importance. Mr. Walker found it better not to attempt to make the bar cut its way into the coal. This has been one of the claims in favor of the bar machine, as in commencing a cut with disc machines it is necessary to make a place with the pick for the disc to enter. Some of the disc machines have arranged to get over this difficulty by pushing the disc into the coal, while revolving by means of a jack behind. The bar was arranged, in the Golden and in the Hurd, to cut its way into the coal, the bar being placed parallel with the coal face, and turning on a pivot in the machine, cutting its way till it came into a position at right angles with the machine, when it simply revolved and cut onward. Mr. Walker found that it was better to make a place for the bar to enter with the pick, as it strained the bar to cut its way in. Another point that was cleared up was the matter of the dust getting into the wheel gearing. The reciprocating motion brings a portion of the bar alternately outside the machine, and takes it back into its bearing. This portion being necessarily well oiled, took up a certain quantity of dust, which worked back into the gearing and caused considerable wear, aided as it was by stray currents of electricity. This, according to the author of the paper, has been cured.

A Long-Distance Transmission Line —110 Miles of High-Tension Conductors.

The Washington Water Power Company, Spokane, is about to begin the commercial operation of its 110-mile transmission line, which is the longest in the Northwest. In the generating station two 2,250-kilowatt, 4,000-volt, revolving field generators, each direct-connected to a Victor turbine, operating under a head of seventy feet, have been installed. The electric machinery, including generators, transformers, switches, lightning arresters, etc., was built by the General Electric Company. The switchboards are installed on a gallery overlooking the whole power-house and all main bus-bars are in separate pottery compartments underneath the gallery. Two sets of bars allow the city service and the transmission system to be separated when necessary. All the generator switches are of the General Electric Company's form H, motor-operated, remote control type. These switches operate so promptly upon closing the relay switch on the switchboard that no difficulty is encountered in synchronizing machines. The exciter is direct-connected to a separate waterwheel without governor. A Lombard governor is installed to operate each of the larger generators; only one of these governors, however, will be used at a time, as a practically constant gate opening on one wheel will be used, allowing the governor on another wheel to regulate for the whole station.

Three water-cooled transformers (with one spare for emergencies) step the voltage from 4,000 to either 45,000 or 60,000 volts, depending upon connections, for the long-distance transmission. There are no high-tension switches other than disconnecting switches installed between the line and the transformer primaries. Lightning arresters are installed, each single-pole arrester being in a separate brick compartment extending from the lower floor of the building to the high-tension wires which are near the roof.

The line is approximately 110 miles long to the furthest power user. A portion of it runs through marshy or boggy country where considerable trouble was experienced last winter from ice forming around the pole butt and finally lifting the pole out of the hole. This difficulty was overcome by putting horizontal cross-pieces on the butts underground. The line consists of three No. 2 solid copper wires, with 60,000-volt Locke insulators and iron pins. These pins are made of about three-inch wrought iron with cast-iron shanks, for insertion in cross-arm, and lead threads.

There are six substations, each equipped with three-phase, step-down, water-cooled transformers, varying in size from 100 kilowatts to 750 kilowatts, with primary taps for 60,000 or 40,000 volts, according to line pressure. Each substation is equipped with an automatic high-tension oil switch mounted in a separate brick compartment above the panel and connected between the transformer primary and line.

The power will be used almost exclusively for mining purposes, the most notable installation being at the Standard and Hecla mines, where four General Electric 300-horse-power induction motors will be used to drive compressors, hoists, etc. One of these motors will be geared direct to a hoist. There is an aggregate of about 800 horse-power in synchronous motors and the balance in induction motors. The synchronous motors will be started direct from the line through low-voltage taps on the transformers.

The plant has already been operated for some time at 60,000 volts, but with no load at the end of the line, and no defects have been encountered. The plant will probably operate commercially within a month.

Philadelphia Branch of the American Institute of Electrical Engineers.

A meeting of the Philadelphia branch of the American Institute of Electrical Engineers was held Tuesday evening, November 10, at the Engineers' Club. A business meeting preceded the reading of the papers, during which a set of by-laws were adopted and new officers elected as follows:

Chairman, Mr. Charles E. Hewitt.

Secretary-treasurer, Mr. H. F. Sanville.

Managers: W. C. L. Eglin, Horatio A. Foster, J. Franklin Stevens, W. L. Hodges, C. W. Pike, A. J. Rowland.

Mr. C. B. Voynow, assistant engineer of the Philadelphia Rapid Transit Company, presented a paper on "A New Method of Track Laying and Bonding." The paper was instructive and interesting, describing as it did the Nichols-Voynow rail joint, which is in use throughout Philadelphia, and which is an entirely new departure from all known methods of track laying. There was a discussion in which Messrs. Pike, Hering, Hodges and Hewitt took part.

Mr. Horatio A. Foster gave to the meeting reminiscences of his experiences in the early eighties when installing and trying to operate the first electric railway in the city of Baltimore for the old Daft company. The talk was very interesting, and in the light of modern practice decidedly humorous.

Mr. Charles E. Hewitt, with the assistance of some lantern slides, showed the development of the railway motor from its beginning to the present time.

The Albert & J. M. Anderson Manufacturing Company sent for exhibition at the meeting their collection of relics of early practice in overhead construction. Some of these relics were very interesting and, placed alongside of the elaborate new devices which were also on exhibition, told better than words of the enormous development in electric traction in the last twenty years.

German Electrical Notes.

It is proposed to connect Teplitz and Klostergrab, two towns in Germany, a short distance from the Saxon frontier, by an electric railroad. As there is already an electric line from Teplitz to Eichwald, it will only be necessary to lay six kilometres of new track.

The Royal Prussian mining office at Rüderdorf in the Nieder Barnin district, province of Brandenburg, has decided to equip the potash mines of that section with electric power. A central plant will be erected to furnish the mines with power for pumping, hauling and loading, work upon which will be begun at once by two Berlin electric companies. It is expected to have the electric equipment in running order by next spring.

At the last meeting of the common council of the city of Sonneberg, Duchy of Saxe-Meiningen, a city of 13,151 inhabitants, it was decided to buy the gasworks of the Sonneberg Gas Company. To accomplish this it will be necessary to raise 600,000 marks ($142,800), which it is proposed to do by a bond issue.

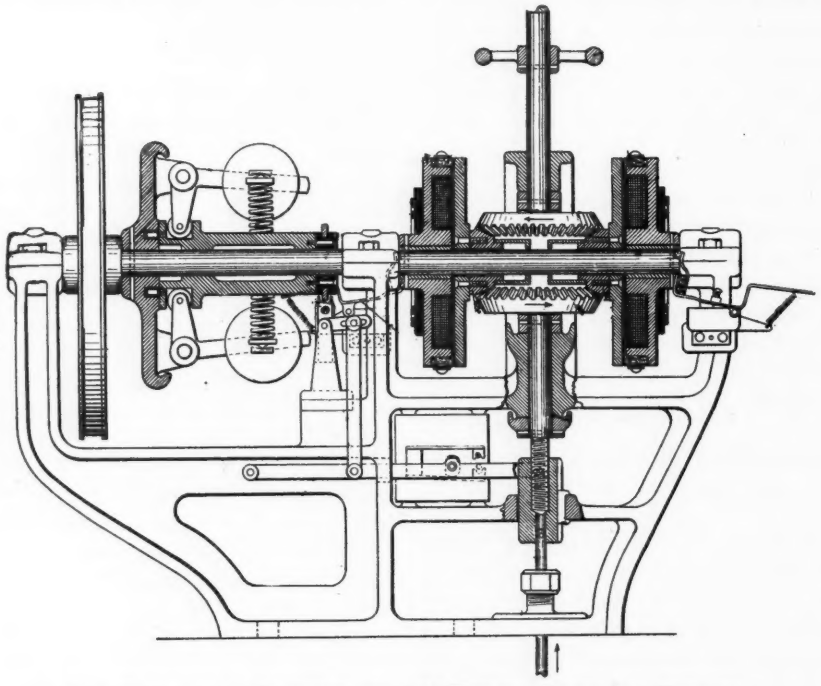
The common council at Zeitz, a city of 28,000 inhabitants, in the province of Saxony, Kingdom of Prussia, has just decided to erect a municipal electric light and power plant.

Arnstadt, a city of 14,585 inhabitants, in the principality of Schwarzburg-Sondershausen, has purchased the Rudolph Levy electric plant and proposes to operate the same in conjunction with the city's gas and waterworks. To do this, however, it will be necessary to make a new bond issue of 240,900 marks ($57,120).

Many German municipalities already own their gas and waterworks and electric and power plants.

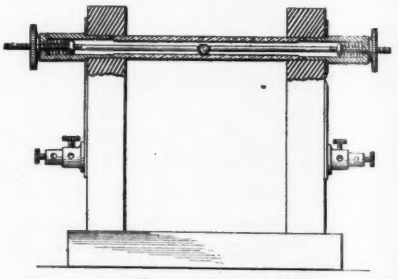
Electrical Patents.

Messrs. William L. R. Emmet and Oscar Junggren, of Schenectady, N. Y., have assigned to the General Electric Company, of New York, a patent recently obtained by them on an electric governor for turbines. In carrying out the invention they subdivide to a greater or less degree the total amount of fluid to be handled, thereby avoiding the use of unduly large parts, which have considerable inertia. On the main or bucket-wheel shaft, or connected so as to rotate in synchronism therewith, is a speed-responsive device which controls the circuit of a pair of electromagnets. A constantly running governor motor is provided, which may with advantage rotate at the same speed as the said responsive-speed device; but the invention is not limited thereto. Each of the magnets controls a clutch coil, by means of which the governor motor is operatively connected to a valve or equivalent mechanism for varying the admission of fluid to the bucket wheel or wheels. When one clutch coil is energized, the controlling valve or valves tend to decrease the supply of energy and when the other is energized to increase the supply of energy. Connection between the source of electric supply and the magnets and clutch coils is made through relatively rotating contacts, so that new contact surfaces are presented when the circuit closes and all danger from imperfect connection is prevented. With a governor of the centrifugal type there is a tendency to overcompensate for changes in load, which tendency is commonly called "hunting." This hunting causes certain variations in speed above and below that desired, which is highly objectionable. To prevent this, there is provided an "anti-hunting" device, which releases the motor after it has performed a certain amount of work and before it has had time to move the controlling valve or valves too great a distance. This releasing action takes place entirely independently of the position of the governor weights. To restate the matter in a different way, the governor weights set themselves in a definite position for a given speed, which causes a movement of the device that controls the admission of fluid to the motor through a suitable intermediary. Now instead of keeping the governor weights and the intermediary in operative connection until the desired position as to fluid delivery to the motor is established, they are disconnected shortly before this condition is reached, and the momentum of the parts is relied upon to bring the parts into the desired relation. In this way objectionable fluctuating is prevented. In order to prevent the governor motor from imparting excessive movement to the fluid-controlled mechanism in either direction, maximum and minimum stop devices are provided, which disconnect the motor when the mechanism reaches either of its extreme positions. It is found desirable to provide circuit interrupters for the pair of magnets which are acted upon by the fluid-controlling mechanism—such as a valve stem, for example—but this can be done in various ways without departing from the invention. The essential thing is to disconnect the governor motor after it has moved the controlling mechanism a certain distance in either direction from a given position and this before it can in any way injure the apparatus.



SIDE ELEVATION OF GOVERNOR AND ANTI-HUNTING DEVICE FOR TURBINES. PRACTICALLY IN SECTIONS.

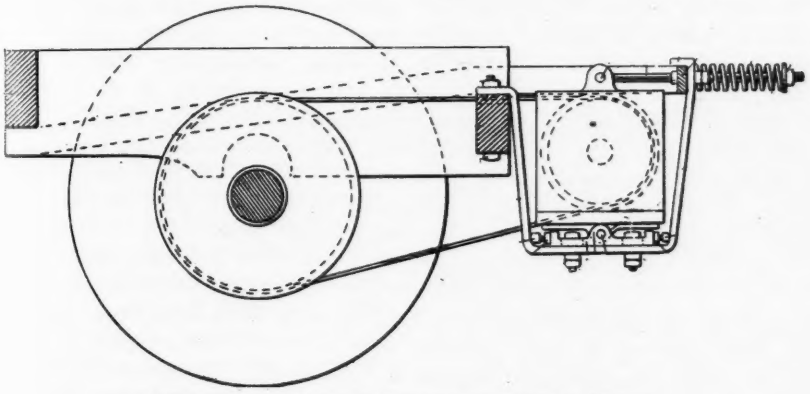
A new coherer for wireless telegraphic systems has been patented by Mr. Louis Dorman, of Washington, D. C. The object is to provide a coherer which insures a continuity of action without deterioration combined with a strong and clear production of the telegraphic signals in the receiving instrument. The device, moreover, is not easily rendered ineffective by atmospheric electricity or disturbances and requires but a very slight electrical energy to make the receiver respond. It also avoids the necessity of a shaking or tapping contrivance, such as is now employed in many instances. A suitable base is employed having spaced standards rising therefrom, each of these standards being provided with a bore or opening. A glass or other tube is fitted in the openings and extends from one standard to the other. Sleeves are also fitted in the outer ends of the openings and constitute supports for threaded rods or stems that project into the tube and are urged inwardly by coiled springs surrounding them. Within the tube and between the ends of the rods is placed a globule or body of mercury of such diameter that it will move freely therein. The salient feature of the invention resides in coating the globule of mercury first with a mineral oil and then with finely-divided or powdered oxide of iron, fine metal filings, emery-dust, or finely-powdered carbon. The application of these coatings or either of them to the mercury gives to the device the power of self-restoration, thereby doing away with the necessity for a tapper or vibrating device commonly known in wireless telegraph systems. Its use results in a stronger and more distinct production of the signals



A NEW COHERER FOR WIRELESS TELEGRAPH SYSTEMS.

transmitted to the receiving apparatus proper and has the effect of rendering the coherer more durable and less liable to get out of order through the effects of atmospheric electricity or from other causes. It also has the effect of requiring less electrical energy for the operation of the system, which facts were ascertained by actual tests between two distant stations where similar tests had been previously made with similar apparatus without the coating on the mercury.

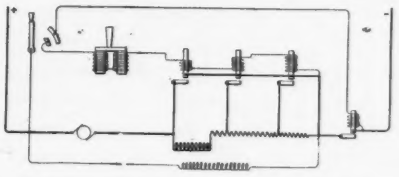
The Consolidated Railway Electric Lighting and Equipment Company of New Jersey has purchased a patent recently granted to Patrick Kennedy, a mechanical engineer of Brooklyn, N. Y., covering mechanism for driving dynamos on railway trucks. Heretofore it has been the practice to locate the dynamo inside of the cross-beams of the bogie truck or, as an alternative, to suspend it from the car body. Each of these has demerits which greatly impair its



MECHANISM FOR DRIVING DYNAMOS ON RAILWAY TRUCKS.

utility in practice. For example, when the dynamo is placed upon the truck inside of the cross-beam thereof, the driving pulley on the axle is necessarily brought closely adjacent to the pulley on the armature of the dynamo. This necessitates in its turn a very short belt from the one pulley to the other, with great liability to derangement of the belt and imperfect or uncertain transmission of power. Further, such an arrangement of the parts makes them difficult of access for inspection, repairs, removal or replacement, and as the dynamo and its accessories are bolted direct to the timbers of the truck their weight is caused to fall upon bolts, which are frequently inadequate to their permanent support under the severe usage to which railway trucks are necessarily subjected when in use. When the dynamo is suspended from the car body, the shaft of the armature of the dynamo is in the turning of curves brought to more or less of an angle to the axle on which the driving pulley is placed, in which case there is great danger of throwing the belt from the pulleys and, in any event for the time being, a material reduction in the transmission of power. The object of this last invention is to obviate these practical difficulties in the transmission of power from car axles to dynamos. To this end there is provided certain new and useful combinations of instrumentalities, whereby the dynamo can be placed outside of the cross-beams of the truck to secure the transmission of power thereto through a driving belt of increased length, whereby the apparatus is made readily accessible for examination, lubrication, etc., whereby it may be readily removed from the truck when required, and whereby it is provided and held in place upon the truck with great stability and security, these advantages resulting in a much greater degree of safety, durability and economy in working than has heretofore been attained in the class of mechanisms to which the invention relates.

A novel controlling device for motor vehicles has been patented by Mr. Joseph Sachs, of Hartford, Ct. Heretofore it has not been safe to leave such vehicles unattended, because mischievous and curious persons have frequently tampered with the mechanism and have caused runaways and serious accidents. Drivers and motormen have also been thrown from their seats upon such vehicles, with the result that the vehicles have continued their movements and accidents have resulted; and the object of the present invention is to overcome these objections and make it nearly impossible for accidents to occur. In carrying out this idea and in addition to the devices employed for operating the motor vehicle and guiding the same, means are provided, mechanically or electrically operated, by which the vehicle can not be started until the driver or motorman occupies his seat upon the vehicle, and which devices go out of action the moment the driver or motorman leaves his position. These mechanically or electrically operated devices must be brought into action before the vehicle can be started, and the moment they go out of action are the medium for causing the



SHOWING SYSTEM OF MOTOR CONTROL.

vehicle to stop. Thus if a mischievous person were to start the vehicle and be unable to control it and be thrown from it, the said devices going out of action would stop the vehicle instantly and there would be no runaway, and the liability of accident would be reduced to a minimum. Likewise if the motorman should be thrown from his seat the vehicle would be caused to stop.

Light Telegraphy.

The system of transmitting telephone messages by means of the rays of an arc lamp, which was developed by Herr Ernst Ruhmer, has been extended to the transmission of telegraph messages, in which work it is thought that it will compete with the heliograph. In the telephone system devised by Ruhmer, the sound waves of the voice are changed into electrical waves by means of the microphone, and these waves are used to vary the intensity of the current passing through an electric arc. Variation of the current caused a corresponding variation in the intensity in a ray of light which was projected to the receiving station, where it was received upon a suitable reflector, and thrown upon a selenium cell. The variations in the light received changed the resistance of the selenium cell correspondingly, and thus were made to reproduce the original sounds in a telephone receiver. In the present system the action is practically the same, except that the variations in current are caused by means of a telegraph key, instead of a telephone transmitter. In this way the Morse signals are sent out, and are received in practically the same way as in the telephone systems. It is thought that this system will be particularly useful for military purposes, where secrecy is desired, as the variations in light can not be followed by the eye or with a telescope, but can only be detected with a proper telephone receiver.

Reviews of Current Engineering and Scientific Literature.

A Polyphase Pumping Station at Bakou, Russia.

At Bakou, on the north side of the Caspian sea, an electric power station has been erected for supplying power to the oil wells in that locality. There are 2,000 oil wells, scattered among a number of villages. These produced last year about 11,000,000 tons of oil. The central station has an output of 1,500 horse-power, and is located near the shore of the sea, so that the water might be used for condensing. There are four tubular boilers, using as a combustible the waste product from the oil refineries. The station contains two 750-horse-power engines, having each three cylinders, and each driving a three-phase alternator which generates 6,500 volts at 100 cycles per second. Each alternator has its own switchboard. The transmission line extends eleven kilometres from Bakou. At substations the voltage is lowered by transformers to 1,100 and supplied to the motors, which have an output of between thirty and fifty horse-power. This type of plant was adopted to diminish as much as possible all fire risks arising from the character of the work.—*Translated and abstracted from L'Electricien* (*Paris*), *October* 24.

An Electrolytic Drilling and Slotting Process.

Experiments have been made by Mr. Sherrard Cowper-Coles, with the object of ascertaining whether it was possible to drill and slot holes electrolytically, and at a sufficiently rapid rate to be of commercial value. Such a process would have many advantages, as holes of any shape could be drilled to templet in hardened armor plates, and could be pierced in position without drawing the temper. The process, no doubt, would also be found very useful for submarine work, as holes could be drilled using the salt water as the electrolyte, the only apparatus required being the drilling nozzle or electrode, and the insulating wire for conveying the electric current. The experiments show that, when an unprotected electrode was used, the holes were not sufficiently true. The apparatus finally constructed consists of a vulcanite cone-shaped nozzle, in which is placed a baffle plate extending almost to the tip of the nozzle. To the end of the nozzle is attached a soft rubber washer having the shape of the hole to be cut. A brass cap is attached to the back of the nozzle, and to this are attached pipes for circulating the electrolyte. The negative electrode is a rod extending nearly to the tip of the baffle plate. In operation, a heavy current is passed through from the plate to be cut to the negative electrode, and the electrolyte is kept in rapid circulation. The iron cut from the plate is deposited on the negative electrode in the form of powder, and is washed away by the rapidly circulating electrolyte. Some of the best results in drilling iron were obtained with a solution of sulphuric acid, though good results have been obtained with salt water. By modification, the machine is made suitable for slotting, as well as for drilling.—*Abstracted from the Electro-Chemist and Metallurgist* (*London*), *October.*

Heating Effects of Radium Emanation.

To settle the question whether the heat emitted by radium is directly connected with the radioactivity of that element, or independent of it, Messrs. E. Rutherford and H. T. Barnes have carried out the following experiments. The heating effects of thirty milligrammes of pure radium bromide was first measured in a differential calorimeter. The radium bromide was then heated to a sufficient temperature to drive off the emanation, which was condensed by passing through a short glass tube immersed in liquid air, and then the tubes were sealed off. In testing the deemanated radium, the heating effect diminished rapidly during the first few hours; fell to a minimum corresponding to about thirty per cent of the original value, and then slowly increased again. On substituting the emanation tube in the calorimeter, the heating effect first increased for a few hours to a maximum corresponding to about seventy per cent of the original heat emanation of the radium, and then slowly decayed with time. At any time after removal of the emanation, the sum of the heating effect of the deemanated radium and of the emanation was found to be the same as that of the original radium. There is an exact parallel between the variation in radiating power, measured by the α rays, and the heating effect. It is thus seen that the heating effect of radium directly accompanies the α radiation from it, and is always proportional to it; and that more than two-thirds of the heating effect is not due to the radium at all, but to the radioactive emanation which it produces from itself. This result accounts for the variation of heat emission with age, observed by the Curies. The amount of emanation from thirty milligrammes of radium bromide was sufficient to cause a bright phosphorescence in the tube, but it was too small either to measure or weigh. The amount of heat emitted from the radium emanation is thus enormous, compared with the amount of matter involved. The results are explained on the disintegration hypothesis, in which the heat is considered to be derived from the internal energy of the atom. If, however, as held by some, radium gains its heat from an external source, it would be necessary to suppose that less than one-third of the heat is due to the radium itself, and that the other two-thirds are due to the radium emanation which is being continually produced, and the power of which of absorbing from an external source decays with time.—*Abstracted from Nature* (*London*), *October* 29.

Treatment of Pulmonary Tuberculosis with High-Frequency Currents and Intralaryngeal Injections of Antiseptics.

High-frequency, low-potential alternating currents have been used by Dr. J. Cunningham Bowie for treating pulmonary tuberculosis, with some degree of success. He found that the passage of a current of electricity through toxins considerably modified and annulled their toxicity, and that the greater the volume of electricity used the more quickly this was accomplished. He concluded that electricity might be of value in the treatment of phthisis or other diseases where bacterial toxins had to be contended with. For this purpose an apparatus which would develop a fairly large current at a high frequency was necessary, and this apparatus should make it possible to regulate the frequency, the voltage and the current at will. An apparatus of this kind was constructed and has been used in a number of cases, the results of which he gives. Almond oil, containing iodine, thymol and other antiseptics, was used for intralaryngeal injection. The current density varied from 300 to 800 milliamperes; the voltage from fifty to seventy, and the time of application from ten to twenty minutes. The arrest of lesion was brought about by this treatment more quickly than by the use of antiseptic oils alone, and the author's experience shows that the high-frequency current promotes healing.—*Abstracted from the Lancet* (*London*), *October,* 31.

Data for a 3,750-Kilowatt Alternator.

The following details are given for the large three-phase alternators which were constructed by Messrs. Dick, Kerr & Company, of Preston, England. One of these, rated at 3,750 kilowatts, has been constructed for the Shawinigan Falls Water Power Company. The rotor spider is of cast iron, the hub being provided with a flange for bolting to the engine flywheel. The spider is pressed on to the shaft in a hydraulic press, and afterward keyed. The laminations are fixed to the spider rim by bolts and cast-iron flanges, the laminations being dovetailed with the pole-pieces. Ventilation is secured by spacers at different positions, the number of these spacers being dependent on the width of the stator. The upper part of the pole-piece is T-shaped. The lower part is dovetailed for fitting on the rim of the rotor. To remove the field coils the pole-piece is made to slide parallel to the shaft, out from the dovetailed groove. The head of the T holds the coil in place. By shaping the pole-face distribution of flux which will produce an approximately sinusoidal-shaped wave of electromotive force is sought. The field coils are of edge-wound strip, insulated by a layer of fibrous material between adjacent turns. The external surface is left bare. The stator frame is built in two parts, the lower being provided with feet which rest upon the bed-plate. In the larger machines the end frame is a special screw for vertically and horizontally centering the stator relative to the rotating field. The winding of the stator is formed of separate coils held in slots by wooden wedges, protected outside the laminations by a perforated cast-iron shield.—*Abstracted from Engineering* (*London*), *October* 30.

Comparison Formulae for Dynamo Electric Machines.

In this article M. R. V. Picou studies critically the value of the several comparison formulæ for dynamos which have been put forward from time to time. He first shows that such formulæ have a very limited use, because while one machine may be better than another for one purpose, for any other purpose the second might be better, and the application of the formulæ must always be considered with these limitations. He then takes the expression for the output of the generator, which is equal to the product of the voltage and current. He finds the voltage of the machine in terms of the dimensions of the generator, the speed, flux, density, etc., and he deduces two expressions for the output, one for a toothed armature, and the other for a smooth core. The resulting formula is practically the same as that known as the Kapp formula. He next takes the various formulæ put forward, and introduces physical quantities in place of the usual constant, and he shows that the power is proportional to the volume of the machine, to the speed, and to the electric and magnetic densities. All formulæ which contain these quantities will have a value, but those which omit any of them can not have any value, and it is useless to insist upon the respective merits of these expressions as an empirical definition of the quantities of a machine. The following expressions, which he deduces, for the output, he thinks is somewhat better than the old Kapp formula.

For smooth core armatures, $P = \pi \alpha H \delta d l v$.

For toothed core armatures, $P = \pi \alpha \beta (1 - \beta) B \Delta h d l v$.

P is the output; α, the ratio of polar arc to polar span; H, flux density in air-gap; δ, the linear density of current in ampere-conductors per circular mils of circumference; d, diameter of armature; l, length of armature; v, linear velocity; β, ratio of tooth breadth to tooth span; B, flux density in teeth; Δ, current density referred to total slot area; h, depth of slot.—*Translated and abstracted from L'Industrie Electrique* (*Paris*), *October 25.*

A Method of Reversing Influence Machines.

When desirable to reverse the polarity of an influence machine, the usual method of procedure is to ground both terminals, give the machine a few turns in the opposite direction, then remove the grounds and start the machine normally. The effect of this operation is rather uncertain, and Herr J. R. Januszkiewicz has devised a system which is more reliable. In this one pole of the machine is connected electrically to the inducing plate for the opposite pole. The machine is then revolved in the normal direction, and if the connection then be broken, the polarity of the machine will be found to be reversed. If the machine is running at a fair speed, but a momentary connection is needed, while if it is running slowly, it may be necessary to leave the connection for ten or fifteen seconds. Care should be taken that good electrical contact be made.—*Translated and abstracted from the Physikalische Zietschrift* (*Leipsic*), *October* 15.

Heating of Railway Cars.

The Western Railway Company, of France, has been experimenting for some time with an electric system for heating its electric and steam cars. Steam heating has been used, but has been found unsatisfactory because of the difficulty of securing an effective distribution of the heat. In the electric system small heaters are placed in the floor between the seats, in such a position that the passengers place their feet upon them, each heater serving for four passengers. For the steam trains the necessary power is collected from a wire carried alongside the track. The voltage for each heater is 110, and the current is one ampere. There are ten heaters to the car. The consumption of energy is 1.1 kilowatts, and the expense is estimated at 3.3 cents per car per hour. The cars are arranged with cross doors, to prevent through drafts. The heaters are eighty centimetres long and forty centimetres wide, and the temperature of the surface is seventy degrees when the exterior temperature is zero, and seventy-five degrees when the exterior temperature is twelve. The temperature of the cars is regulated automatically.—*Translated and abstracted from the Revue de l'Électricité* (*Berne*), *October* 15.

Magnetic Experiments on Metals.

From published results of an investigation of the connection between the magnetization and mechanical deformation of ferromagnetic materials, which work has been carried on by Messrs. H. Nagaska and Honda, of Tokio, it seems that in reversible nickel-steel, such as is used for scales, on account of its small expansion, mechanical elongation in the direction of magnetization produces an increase of magnetization. The same substance stretches on being magnetized, especially when it is annealed instead of being hardened. Iron, steel, nickel and nickel-steel increase in volume by magnetization, but cobalt shows contraction. The greatest volume of change was observed in a nickel-steel containing twenty-nine per cent of nickel, in which it has in a strong field forty times that of iron. The twisting produced by the combined action of circular on longitudinal magnetization in iron, nickel and nickel-steel increases with the longitudinal field strongly, and reaches the maximum, whence it decreases gradually, as the field is further increased. The sense of twist in iron and nickel steel is opposite to that of nickel. The transient current produced by twisting a longitudinally magnetized wire, and the longitudinal magnetization caused by twisting a circularly magnetized wire, are reciprocally related to the twist produced by longitudinal and circular magnetization.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Enclosed Fuse.

A novel type of enclosed fuse for light and power circuits has been perfected by Edward W. Anger, Jr., of Chicago, Ill., who has made application for patents on the device. The American Electric Fuse Company has made an exclusive contract with the inventor for the manufacture and sale of this apparatus, and has placed the device in its New York, Chicago and Atlanta offices.

FIG. 1.

The new apparatus is called the "Usable Fusible fuse." It is so constructed that it will fit the standard type of fuse blocks in common use. Later on the manufacturer will fit it to a special block. The fuse consists of two parts—the operating portion, containing the fuse wire, and a holder. The fuse wire is the only part of the device which is destroyed when the fuse operates. The tube containing the fuse wire, the outer shell, with holder, and the terminals, are not affected. The holder and terminals are designed to be permanent.

FIG. 2.

The manufacturer states that the initial cost of this fuse will be but slightly higher than the ordinary type, while there will be a decided saving in renewals. In addition to this, the fuse acts as a positive mechanical indicator, which, without exposing any part of the fuse, gives a visual signal which can be seen at a considerable distance. This indicator can be made to close an alarm circuit upon the blowing of the fuse. The renewals after the fuse is operated through an excessive current are made easily, and the design of the fuse eliminates the possibility of making a mistake with regard to the carrying capacity or the fusing point of the renewed or repaired fuse. This is one of the most important features of the apparatus.

The fuse embodies new safeguards and the redesigning of old principles, with special reference to the requirements of the underwriters' rules and specifications. It places new difficulties in the way of the improper use of fuses, and makes easier and more practicable the employment of proper protection. It is stated that the fuse has been tested by the inspectors of the National Board of Fire Underwriters and has been approved.

The indicator of the fuse, apart from the fact that it can be utilized to sound an alarm, has other features of merit. It is placed at the end of the fuse, instead of along the side, and forms no part of the fuse itself. It is operated by a spring, which is released when the fuse blows, and does not make any smoke or flash when operated.

The accompanying illustrations are of a five-ampere fuse with screw contact type of terminals. The fuse is made in any desired carrying capacity, with slight variations in construction for larger sizes, and it is also made with the spring clip type of contacts to fit the standard spring clip blocks already in use.

FIG. 3.

In outward appearance this fuse does not differ materially from the types of enclosed fuses in general use. The terminals, as shown in Fig. 1, are of heavy brass of the standard design for the particular size of fuse with which they are used. The fuse cover is of heavy fibre. It will be noticed that there are two distinguishing points of difference in the outward appearance of the fuse. At point A, in Fig. 1, appears a rectangular hole, and just above it a vertical slot, in the end of the fuse. At the opposite end of the fuse there also appears a screw which is not used with other types of enclosed fuses. A better view of this other, or screw end, is shown in Fig. 2 in which the terminals are reversed from the position shown in Fig. 1 and in which a wire will be seen passing through the round hole B and fastened under the head of screw A.

The purposes of these features are not evident from its outward appearance, but they are readily understood by reference to Figs. 3 and 4, where it will be seen that the fuse in reality consists of two distinct elements or parts. Fig. 3 contains all of the operating parts of the fuse,

FIG. 4.

Fig. 4 being merely a cover, to one end of which is fitted one of the terminals.

Fig. 3 in its turn is composed of two separable parts, shown in Figs. 5 and 6. Fig. 6 is the fuse proper, Fig. 5 being merely a holder or terminal for one end of the fuse.

The fuse proper (Fig. 6) consists of the copper strip terminal B, the wire terminal C, a fibre tube with a metal cap at each end enclosing the fuse wire, the fuse wire itself and a fire-killing powder surrounding the fuse wire. The fuse wire is not in one piece, as is the case with other enclosed fuses, but is in two separate lengths, which parallel each other, but do not touch, in the middle of the fuse casing. One of these fuse wires is much heavier than the other, that is, it has a larger current-carrying capacity. This heavy or main fuse is made of regular fusible metal and is soldered at its ends to the terminals B and C (Fig. 6) at the point of junction between these terminals and the metal caps at each end of the fuse casing. The smaller or supplemental fuse is made of hard drawn non-stretching copper wire and is soldered at one end to the wire terminal C, inside the metal cap, and at the other end it is not soldered at all, but passes freely through a hole in

the cap, terminating in the loop A (Fig. 6). The main and supplemental fuse are therefore in multiple or parallel with each other, and combined they have the current-carrying capacity or fusing point required in the fuse.

In order to understand the reason for this arrangement, we refer again to Fig.

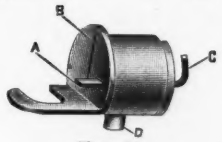


FIG. 5.

5. In this figure the slot B is adapted to receive the strip terminal B of Fig. 6. The hook C (Fig. 5) is one end of a trigger-shaped metal piece which passes through the body of Fig. 5 and terminates in the external projecting point A. This trigger is forced out of the slot in the end of the terminal (Fig. 5) by a spring located inside of the terminal head and not shown in the illustration. When strip terminal B (Fig. 6) is slipped into slot B (Fig. 5) the loop A (Fig. 6) is at the same time passed over the hook C (Fig. 5), and the whole fuse proper (Fig. 6) is drawn back until the end of strip B (Fig. 6) is flush or even with the end

FIG. 6.

of the slot B (Fig. 5). Strip terminal B is then fastened in the slot B by a screw set into the terminal on the opposite side from that shown in Fig. 5, and therefore not appearing in the illustration.

When the fuse proper (Fig. 6) is drawn back preparatory to fastening the terminal B in the slot B, the trigger AC (Fig. 5) is also drawn back by the loop A (Fig. 6) until the projecting end of the trigger is even with the end of the terminal. This presents the appearance shown in Fig. 3, where the trigger appears held in place by the loop A and just flush with the end of the terminal at point C. The fastening screw holding the strip in slot B (Fig. 3), as before mentioned, is on the opposite side of the terminal, and not shown in the illustration.

The two parts (Figs. 5 and 6) having been joined as described to constitute Fig. 3, the cover (Fig. 4) is slipped over the end of the completed Fig. 3 from the right, the wire C (Fig. 6) being passed through the hole in the end of the terminal as shown at point B (Fig. 2). The holder (Fig. 4) is notched at its lower end, and after being passed over the fuse it is twisted, the projecting point D which fits into the notch (Fig. 3) then holding it firmly in place.

The fuse, in position in its block before being blown by an excessive current, presents the appearance shown in Figs. 1 and 2. After an excessive electric current has passed through the fuse and blown out the fuse wire, the indicator, which is concealed during the passage of a normal current, is released in the manner described and the projecting end gives the signal to the inspector or repairman, as stated, that the fuse has been blown; the fuse presenting the appearance shown in Fig. 7. The only difference, as will be seen, between Fig. 7 and Fig. 1 being the fact that the point A in Fig. 7 is visible, whereas in Fig. 1 it is concealed inside the terminal head, indicating that the fuse in Fig. 1 is still intact.

The inspector or repairman, noting that the fuse had been operated, removes it from the fuse block. He then releases the wire held under the screw A (Fig. 2) and pulls off the cover (Fig. 4). When the cover is removed, the operated fuse will present the appearance shown in Fig. 8, in which the trigger B is shown to have been released by the burning out of the supplemental fuse, the end loop of which held it in place under normal conditions. The projecting trigger A is forced out by the spring inside the head of the terminal. The repairman next loosens the screw which clamps the strip into place in the slot and the operated fuse is removed; a new fuse (Fig. 6) of the proper size being inserted in its place and fastened by the screw the same as the fuse which has just been removed. The cover is then slipped back into place and the wire fastened under the screw in the opposite terminal, the renewed fuse being then ready to be placed again in the block.

The fuse (Fig. 6) is furnished with the strip terminal B and the wire terminal C instead of two strip terminals or two wire terminals, in order to prevent the possibility of re-fusing the holder (Figs. 4 and 5) with either an ordinary piece of copper wire or an ordinary copper strip. While a strip would pass easily through slot B in Fig. 5, it would not pass through the hole B in Fig. 2; and conversely, while a wire could be easily placed in the hole B, Fig. 2, it could not be placed in slot B, Fig. 5. This safeguard makes it practically impossible to repair the holder without using the proper fuse designed for it. The various sizes of fuses are arranged with different sizes of holders, slots and holes for the fuse terminals. The fuses themselves or renewable parts are also made in different lengths and diameters for the different sizes. It is therefore impossible to fit a wrong fuse in any holder and the holder on any block, being correct for any particular size of fuse, it is impossible to use any larger size of fuse than the proper one. The use of ordinary bare fuse wire or strip is also absolutely prevented.

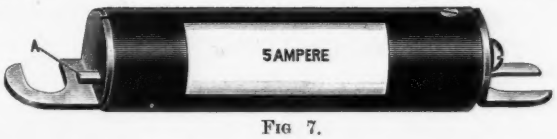


FIG 7.

FIG. 8.

A New Form of Steel Tie.

Mr. Cortlandt De Cew, an inventor, of 173 Flatbush avenue, Brooklyn, N. Y., has devised a form of steel tie to take the place of the ordinary wooden tie, as used in both steam and street railway systems. This is a steel tie formed of spring steel, and is made partially hollow, resembling a narrow figure eight in design. The bottom portion is flanged, so that the base is about twice as wide as the upper face. The rail is held against the tie by means of lugs, which work in reciprocating bevels under the action of tie bolts. These tie bolts are inserted in slots from the upper surface of the tie. The beveled lugs are then put in place, and the lag nuts screwed down. It follows that the tighter the lag nuts are screwed, the better will be the hold made by the beveled lugs on the base of the rail.

The inventor claims that this tie will do away with fish-plates, angle irons and cross-bars, and will keep the rail from spreading, no matter how heavy the service or high the speed. The partly hollow construction of the tie, and also the flange on the base, will allow of a firm hold in the ballasting of the road, and will also keep the ties from shifting under severe conditions.

The steel tie can be used in conjunction with the wooden tie, replacing the wooden ties which have become unfit for service, and in this way eventually taking the place of all the wooden ties, at the same time rendering it unnecessary to make the complete conversion from the wooden to the steel ties.

Slow and Moderate Speed Motors.

The slow and moderate speed multipolar motors manufactured by the General Electric Company include many of the latest improvements attained in the construction of electrical machinery.

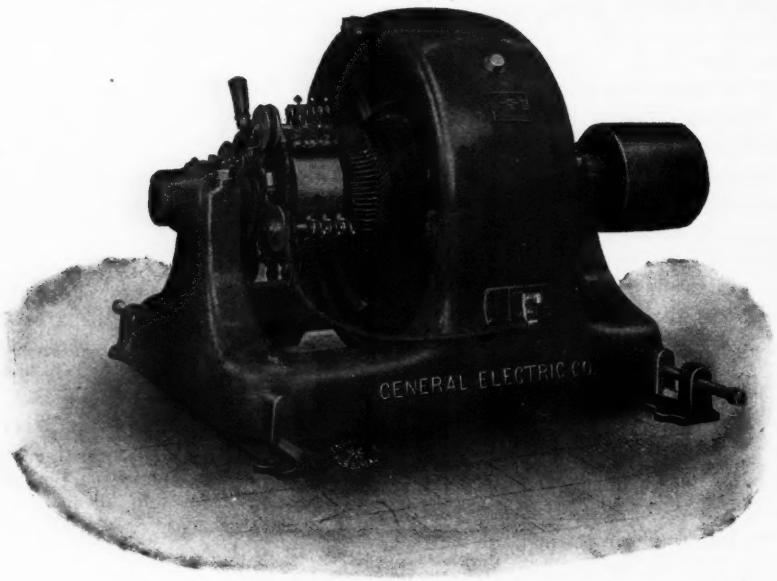


FIG. 1.—FIFTEEN-HORSE-POWER SLOW-SPEED MOTOR.

The four-pole construction is adopted. The magnetic circuits with the four-pole type are shorter and result in reduced exciting current, greater output, and higher efficiency with a given weight and speed.

The standard motors are designed to run at very slow speeds that will suit the requirements of almost all cases. The value of slow speed in machinery is generally understood, but in power motors economy warrants additional outlay to secure slow speed and the resulting diminished wear and friction losses in belt, bearings and commutator. The slow belt speed used with these motors is an advantage of importance, since it permits them to be belted directly to ordinary slow speed line shafting without intermediate counter-shafting.

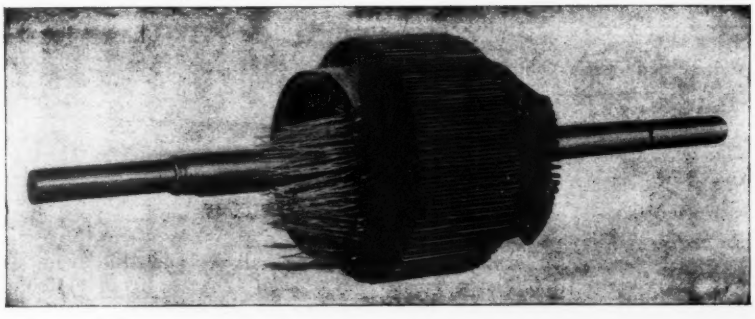


FIG. 3.—ARMATURE PARTLY WOUND.

In motors of any given design, a reduction of speed necessarily requires an increase of weight to obtain the same output and maintain equal excellence of construction. By the adoption of the four-pole type an economy of material is effected which results in a machine of large output but comparatively light weight. The frames of slow and moderate speed motors are made of the best quality of iron, and the pole-pieces of special soft steel, the combination permitting the construction of a motor very much lighter than even higher speed motors of the same output.

These motors, the manufacturer states, are so designed that practically no sparking occurs at the commutator, and changes from no load to overload can be made without shifting the brushes. The only wear upon the commutator is that due to friction, which with carbon brushes employed for all voltages and sizes is so slight as to be practically negligible.

A particular feature of these motors is the low running temperatures of all the parts, secured by so designing the motor that losses are reduced and free circulation of air provided through all moving parts.

After running continuously for ten hours at rated full load, the rise in temperature above the surrounding air will in no part of the machine exceed forty degrees centigrade with the exception of the commutator where the rise will not be more than forty-five degrees centigrade. The motor will also operate for one-half hour at twenty-five per cent overload, and withstand temporary overload of fifty per cent, without injurious heating.

The following are a few of the leading features which the maker calls attention to:

The armature coils are machine made, separately insulated and tested, and are interchangeable throughout each size and voltage of motor. They are embedded in slots in the face of the core and protected from mechanical strain or tendency to abrade the insulation.

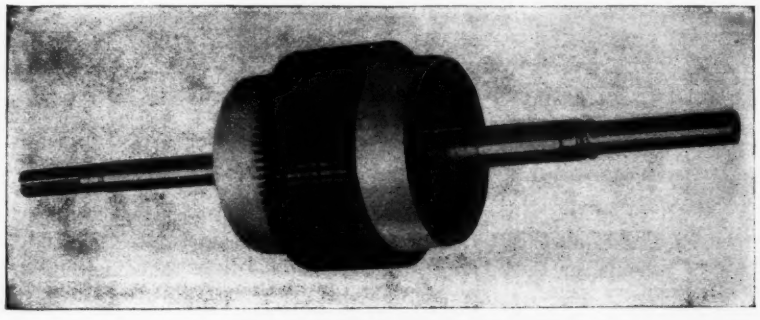


FIG. 2.—ARMATURE BODY, BEFORE COILS ARE PLACED.

The projecting flanges of the spider rigidly support the armature windings, and besides affording additional radiating surface, protect the windings from oil or mechanical injury. The commutator and brushes operate well under all conditions of load. The armature is so constructed that currents of air are constantly circulating through the core and windings, thus cooling all its parts.

The brushes are provided with a flexible conductor which is connected to the brush-holder, and allows a free movement of the brush in the holder and avoids the resistance due to imperfect contact.

The pole-pieces being separable the field coils can be removed without disturbing

either the frame or the armature. The pillow blocks of the four-pole type are cast with the bed-plate, ensuring the proper centering of the armature in the fields. All bearings are self-aligning and automatically lubricated. The frame is divided in a horizontal plane, permitting easy access to the armature.

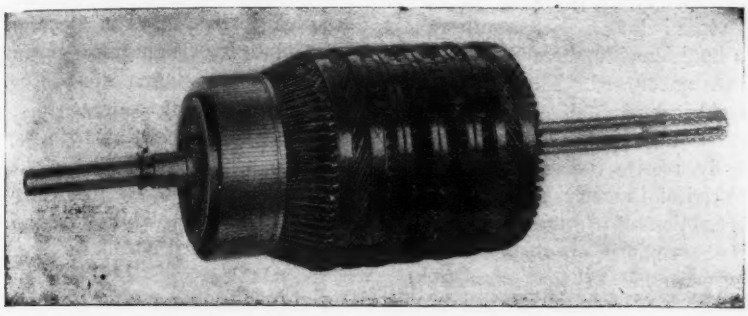


FIG. 4.—COMPLETE ARMATURE WITH COMMUTATOR.

The accompanying illustrations show an armature body before the coils are put in place, an armature partly wound and a complete armature with commutator. It will be observed that the spider castings which hold the sheet-iron laminations in place are extended at both ends of the armature. The armature coils are arranged on the surface, and form a cylindrical winding with the ends slightly tapered instead of projecting abruptly down toward the shaft, according to a construction frequently adopted. The cylindrical winding has many advantages. By its use a very large radiating surface is provided for the armature conductors, and serves to keep the armature cool. The length of wire is reduced to a minimum; consequently the losses due to armature resistance are reduced and the efficiency of the machine is increased. With the cylindrical winding, the removal or replacing of a coil is a matter of simplicity. The coils are embedded in slots punched in the armature discs and are firmly bound in place between the teeth and on the cylindrical extensions by band wires, so that no part of the armature can move or vibrate in the slightest degree. Rigidity is one of the most important advantages of the cylindrical form of armature winding, since without motion no injury or deterioration of the insulation is likely to occur. Connections between the armature and commutator are arranged to prevent the possibility of open-circuiting.

The coils are wound, insulated and tested before assembling on the armature, and any fault of construction, such as imperfect insulation causing short-circuiting of the coil, is practically impossible in the finished armature.

The insulation used is similar to that employed in the General Electric railway motor armatures. It is tough, impervious to moisture, and practically indestructible, except by very heavy overload. It has high resistance to puncture, making injury by lightning improbable.

Since the coils when placed in position on the armature are complete, the danger of abrading the insulation is reduced to a minimum. On the other hand, to wind the wire directly on the armature, as is commonly done, makes it necessary to drive each separate conductor into place, thereby running a great risk of destroying the insulation, and rendering the damage more troublesome because it is hidden.

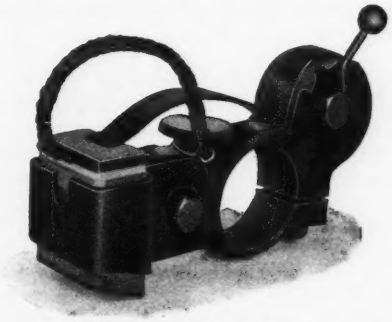


FIG. 5.—BRUSH-HOLDER.

The bearings are of the self-aligning, self-oiling type used with success in all the later General Electric machines. The bearing is so constructed that a continual supply of oil is carried from the reservoir by the revolving rings and swept by the turning of the shaft toward the centre and ends of the bearing. It is there collected and returned to the reservoir, where it has time to settle and cool. In this manner a continual circulation of oil through the bearings is automatically maintained, and the bearings require no attention beyond an occasional examination and renewal of oil.

All sizes and voltages of slow and moderate speed generators are supplied with the General Electric Company's type CS brush-holders. This holder and its attendant parts are as light as is consistent with strength, and therefore they have small inertia and will follow the commutator at any speed. The brush has perfect contact over the entire contact surface. It is so proportioned and supported that it stands firmly on its base and operates without chattering.

Uniform pressure throughout the wearing length of the brush is secured by a spiral spring having many convolutions. With this type of pressure spring, no variable friction is introduced which would tend to change the pressure on the brush after it is in actual operation. The mechanism is so designed that the brush may be removed by simply throwing a spring out of a notch.

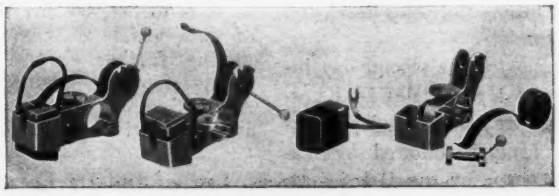


FIG. 6.—BRUSH-HOLDER AND PARTS.

Founder's Day Exercises at the Clarkson Memorial School of Technology.

The trustees and faculty of the Thomas A. Clarkson Memorial School of Technology, at Potsdam, N. Y., have issued invitations to the founder's day exercises, which will be held Monday evening, November 30, at eight o'clock. Dr. F. A. C. Perrine will deliver the address of the day.

Electric Vehicles to Handle United States Mail in Philadelphia, Pa.

The United States Government has decided to make use of electric automobiles to carry the United States mail in the city of Philadelphia, Pa. This service was inaugurated on November 1, and the tests made appear to prove conclusively that there will be a large saving, both in time and money, over horse-drawn vehicles. Second Assistant Postmaster-General W. S. Shallenberger notified Mr. George W. B. Hicks, superintendent of the Electric Vehicle Equipment Company, of Philadelphia, Pa., that the company's bid for the contract was acceptable to the United States Government. It is thought that the introduction of the electric automobiles for the mail service in Philadelphia will be the forerunner of a universal adoption of electric delivery wagons for this service.

The Independent Telephone Association of Southern Indiana.

The fourth annual convention of the Independent Telephone Association of Southern Indiana was opened with an address by Vice-President Knoefel, in Evansville, November 10. Mayor Covert was not present to welcome the visitors to the city, and his address of welcome was read by W. E. Clarke, of the board of public works. Mr. Knoefel responded. President Kienle was absent from the convention on acount of ill health. Representatives and officials of a large number of the independent telephone companies in the territory covered by the association were present, and the meeting is said to have been one of the most successful ever held.

In his address Mayor Covert called attention to the fact that Evansville was surrounded by a network of independent lines, and that the business interests of the city demand that such connection be given it. He urged the members of the convention to take up the fight to secure the independent service in the city, and thought a concerted effort upon the part of all the members of the association would have the desired effect.

One of the principal speakers of the session was City Attorney Funkhauser, who outlined the telephone situation in Evansville and went into the details regarding the status of the city and existing company. Mr. Funkhauser's remarks were discussed by Mr. Armstrong, president of the Home Telephone Company, of Louisville, Ky., and by several other telephone men, including J. R. Tyler, of Chicago; H. Langrebe, of Huntingburgh; L. G. Davis, Salem; H. J. Cole, Owensboro, Ky.; F. E. Ebersole and T. M. Thom, Lamar, and others.

On the evening of November 10 the visitors were given a banquet which was greatly enjoyed. Mr. E. W. Pickhardt was the speaker of the evening, and he was followed by the Hon. George A. Cunningham and a number of other local and out-of-town men.

The programme for the second day included a paper by Mr. Charles D. Knoefel, of New Albany, on "Independent Long-Distance Lines," followed by discussion; and a paper by the Hon. A. J. Payton, of Rockport, on "The Bell People as Antagonists."

After general discussion and reports of committees, the following officers were elected for the year: president, Charles D. Knoefel, New Albany; vice-president, L. G. Davis, Salem; secretary, E. W. Pickhardt, Huntingburgh; treasurer, T. M. Thom, of Lamar.

Electric Railway Tests at the Louisiana Purchase Exposition.

In view of the growing importance of the electric railway interests of this country, plans are being carried into effect which contemplate a very prominent recognition of the electric railway and electric railway problems at the St. Louis Exposition. The appointment of an advisory commission on electric railway tests of the Louisiana Purchase Exposition has just been announced. The commission is thoroughly representative of each branch of electric railway activity and will, undoubtedly, receive the support of the entire electrical industry in any plans for the promotion of electric transportation which the commission shall devise.

The personnel of the commission is as follows:

Mr. J. G. White, president J. G. White & Company, New York city, chairman; Mr. H. H. Vreeland, president Interurban Street Railway, New York city; Mr. W. J. Wilgus, vice-president New York Central & Hudson River Railroad, New York city; Mr. George McCulloch, president Union Traction Company of Indiana, Indianapolis, Ind.; Mr. J. G. McGraw, president McGraw Publishing Company, New York city.

The commission will act in an advisory capacity in connection with a series of tests on electric railway apparatus to be conducted at the exposition under the auspices of the Department of Electricity.

Electric railway test tracks have been laid north of the Transportation Building on the exposition grounds, and represents a practically level clear double track, 1,400 feet in length. These tracks will connect with the intramural railroad and also the steam railway system serving the grounds. It is said that several important manufacturers have already promised complete equipments for exhibition and test, and the present outlook indicates that all of the new systems of alternating-current propulsion, as well as the old direct-current system, will be offered for inspection and operation.

It is not so much the intention to conduct these tests in a competitive sense as it is to arrange for the accumulation of data which will be valuable in promoting further electric railway undertakings from an engineering standpoint. A very complete equipment for testing apparatus will be provided.

Test of the De Forest System of Wireless Telegraphy.

It is reported that a demonstration of the De Forest system of wireless telegraphy is shortly to take place between Holyhead, Wales, and Dublin, Ireland, and that those interested in the system intend incorporating a British Empire De Forest company upon the completion of the tests.

Electrical Phenomena.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

On the thirtieth of last month a four-mile, high-tension, highly insulated, underground paper cable, while in service, punctured its insulation and became disabled.

After a thorough investigation, the cause of the breakdown could not be accounted for, other than it might have been due to electrostatic surgings influenced by maximum sun spots changes which were then prevalent.

In order to substantiate the theory herein advanced, it is only necessary to learn of others who had similar breakdowns with their cables while in service and under the same conditions.

Between the hours of 6.30 A. M., October 30, and 6.30 A. M., October 31, or thereabouts, every piece of electrical apparatus or system in service throughout the world was affected by these strange phenomena. Any information on the above subject that may be gathered through your valuable paper or sent direct to the writer will obviously admit of the proper solution of the theory herein advanced.

It is announced that the sun spot changes indirectly caused the trolley system of Geneva, Switzerland, to become disabled to the extent of stopping the cars for a time during this period of disturbance.

EDWARD DURANT.

New York, November 11.

[About the end of last month or the first of November, magnetic disturbances were observed in several quarters of the world. These appear to have been coincident with the discovery of several new sun spots, and the matter of several breakdowns was attributed to electrostatic effects.—ED.]

American Street Railway Association.

The report of the twenty-second annual meeting of the American Street Railway Association, held at the Grand Union Hotel, Saratoga Springs, N. Y., September 2 to 4, has been issued. This contains a splendid report by Mr. Jere C. Hutchins, president of the Detroit United Railway Company, Detroit, Mich. The new officers of the association are: president, W. Caryl Ely, president of the International Railway Company, Buffalo, N. Y.; first vice-president, Elwin C. Foster, president New Orleans Railway Company, New Orleans, La.; second vice-president, John Grant, general superintendent St. Louis Transit Company, St. Louis, Mo.; third vice-president, James F. Shaw, general manager of the Boston & Worcester Street Railway Company, Boston, Mass.; secretary and treasurer, T. C. Penington, treasurer of the Chicago Street Railway Company, Chicago, Ill.

Lecture before Automobile Club.

On Tuesday, November 17, Mr. Lamar Lyndon, the well-known electrical engineer and storage battery expert, delivered a lecture before the Automobile Club of America, at its headquarters, 753 Fifth avenue, New York city, upon "The Storage Battery, Its Underlying Principles, the Causes of Its Action." The lecture was illustrated with lantern slides, and many experimental demonstrations were made.

Mr. Lyndon first defined and explained the fundamental electrical units. He then described the elementary chemical actions which are involved in all batteries. The primary battery was explained and illustrated, and it was shown that the actions taking place there and in the storage battery are analogous; that the storage of energy is a chemical, and not an electrical, reaction, the storage battery differing only from the primary battery in that it is reversible and can be restored to its original condition by passing a reverse current through it. The part played by the electrolyte was fully described, showing how variations in density of the sulphuric acid will produce corresponding variations in the electromotive force.

The two types of battery were then taken up—the Faure and the Planté—and in demonstration a cell of each type was made. The lecture proved to be interesting and instructive, and was much enjoyed.

Mr. Lyndon will deliver a second lecture—a continuation of the first—on Tuesday, December 1, on "The Practical Operation, Deterioration and Management of a Storage Battery."

Telpherage.

The paper by Mr. Charles M. Clark on "Telpherage," which was read before the American Institute of Electrical Engineers, on April 25, 1902, has been reprinted by the Government Printing Office, Washington, D. C., from the Smithsonian report for 1902. This paper is a very complete description of all forms of hoisting and conveying operation in industrial service.

New York Electrical Society.

At the 238th meeting of the New York Electrical Society, which will be held at 19 West Forty-seventh street, New York city, on Monday evening, November 30, Mr. W. D'A. Ryan will lecture on "Practical Problems of Lighting and Illumination."

The Magnetic Storm.

The foreign technical papers which have just come to hand give reliable accounts of the magnetic storm which occurred the last two days of October. In England serious earth currents affected the telegraph system, currents up to sixty milliamperes being observed. This is about four times the average working current for long lines. A similar state of affairs also occurred in France and throughout the other countries. An interesting effect of the storm was that the submarine cables were but slightly affected, the greatest trouble being encountered on the short land lines. The difference in the action is explained by the fact that the submarine lines use syphon recorders and condensers, so that the effect of the storm merely shifted the zero point of the recording pen, but with the land lines, the earth currents were sufficient to hold over the relays and thus stopped communication.

Two interesting communications discussing the storm are given in the London *Electrician,* for November, one of these being from Dr. Charles Chree, superintendent of the Observatory Department at Kew. After an account of the phenomena observed, Dr. Chree says that the storm was remarkable, not merely because of the great range of the magnetic elements, but for the exceptional number of large oscillatory movements. As to the cause of magnetic storms, he thinks that there is no evidence of any connection with earthquakes or other internal troubles of the earth itself. In regard to the sun spot theory, Dr. Chree says: "As to the common cause of aurora and magnetic storms, we are still in the stage of theory. The amplitude, both of irregular and the regular diurnal changes of terrestrial magnetic force is conspicuously larger in years of sun spot maximum than in years of sun spot minimum. It is thus natural to regard the two phenomena as related, but the various attempts that have been made to associate them as cause and effect have not been very successful."

The second letter, from Sir Oliver Lodge, calls attention to the fact that Arrhenius has shown clearly how flying electrons would be deflected by the earth's magnetic field, and carried toward the poles, in such a way as to account for auroræ in a very satisfactory manner. "Furthermore," says Sir Oliver, "the known emission by radium of charged particles at excessively high velocities makes it very easy to suppose that the sun is doing the same sort of thing, though possibly not for the same sort of reason. Everything, in fact, tends to make it almost certain that the old speculations of Fitz-Gerald, as to magnetic storms being due to actual projectiles of minute size certainly, in enormous numbers, flying past the earth at great speed, is a true explanation of the observed effects."

Prophecy of Trans-Atlantic Telephony.

The following cable despatch appeared in the New York *Sun,* Sunday, November 15.

LONDON, November 14—Prophecy is dangerous, but with a full realization of its pitfalls the correspondent of *The Sun* ventures the following prediction: Within three months, probably before New Year's, direct telegraphic communication, without intermediate repeating stations, will be established for the first time between New York and London, and telegrams will be exchanged at a speed of more than four times the previous capacity of any cable.

I am tempted to go a step further and express the strong expectation that within a year it will be as feasible to converse by telephone between *The Sun* building in New York and the *The Sun's* London office as it is across Manhattan.

Perhaps it is as well to confess that it is easy to prophesy when you know. The feat of rapid communication between London and New York as a matter of fact has been greatly surpassed recently in actual practice; in other words, the problem of cheap and rapid long-distance communication has been solved, and the credit for this signal triumph of modern science belongs to England.

I am compelled to await the permission of the inventors before making more than this general announcement.

Wireless Telegraphy between France and England.

The introduction of the first regular wireless telegraph service in France is due to the initiative of the Railway Company of the West, which, together with the Brighton company, of England, will install stations at Dieppe and Newhaven. The system of Octave Rochefort will be used. The installation of the service has been confided to the Mors Society, of Paris, well known for its electrical appliances and automobiles.

Society of Chemical Industry.

The Society of Chemical Industry, New York section, announces the following programme for the session on Friday evening, November 20: opening address of the chairman, Mr. Virgil Colentz on "The More Recent Medicinal Synthetics;" address by C. Baskerville, and T. B. Foust on "Rare Earth Mordants;" address by Oskar Nagel on "Vegetable Protein."

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

WATER POWER PLANT FOR MEXICO—It is announced that a large water power plant is to be erected on the river Yaqui, state of Sonora, Mexico. The concession has been granted to Carlos Garza Cortina, of Mexico City. It permits the utilization of 70,000 litres of water per second.

POLICE TELEGRAPH WIRES IN BROOKLYN TO BE BURIED—The police telegraph wires serving the Borough of Brooklyn, N. Y., are to be placed underground, an appropriation of $40,000 having been made for this purpose. The work will be done under the supervision of Mr. Frank C. Mason, superintendent of police telegraphs. It is understood that a new conduit system will be installed.

SCHENECTADY RAILWAY STOCK INCREASED—Announcement is made that the Schenectady Electric Railway Company has received authority from the state railroad commission to increase its capital stock from $600,000 to $7,000,000. This company operates in Schenectady, Albany and Rensselaer counties. The increased capital is to be used for improvements and for the absorption of the stock of the Mohawk Gas Company, of Schenectady.

OHIO RIVER POWER—President W. Kelsey Schoepf, of the Cincinnati Traction Company, and a party of capitalists and electrical experts, recently made a trip to Louisville to ascertain how much electricity could be generated in the falls of the Ohio, and whether the amount would be sufficient to warrant its being transmitted to Cincinnati and Indianapolis. It is proposed to utilize the Ohio river falls for power for electric lighting, traction and other plants throughout the Ohio valley.

EXPERIMENTAL TRAINS IN THE NEW YORK SUBWAY—It is now expected that within a very short time an experimental train will be run in the Rapid Transit Subway, New York city, between the City Hall and 104th street, or possibly as far north as 150th street and Broadway. The regular passenger service of the underground road, it is estimated, will begin as early as March or April, 1904. The Harlem river section will not be finished until next spring, nor will the section under Washington Heights be finished before that time. The incompleteness of the power-houses may cause a delay in the opening of the road for regular passenger traffic.

NEW YORK INDEPENDENT TELEPHONE COMPANY WILL NOT BE GRANTED A FRANCHISE—Justice Clark has decided that the Independent Telephone Company can not use the subway built by the Rapid Transit Construction Company, of New York city. The decision is on the motion for a mandamus asked for by the telephone company to compel Commissioner Robert G. Monroe to issue a permit to the corporation. Justice Clark says he does not think the telephone company has proved its right to lay its wires in the subway, but as its case is the first one in which the question at issue has been raised, he denies the application, with the intimation that the point ought to be settled by an appeal to the Appellate Division.

LARGE RAILWAY DEAL—The Public Service Corporation has arranged for the purchase of all the stock of the Central Electric Company, which is located at Metuchen, N. J., and which supplies light and power to that town, besides the municipalities of New Brunswick, Perth Amboy, Rahway, Woodbridge, Raritan Township, Carteret, Bound Brook, Dunellen and South Plainfield. The Central Electric Company has a capitalization of $750,000, with an issue of bonds aggregating a like amount. The company was organized a few years ago by the consolidation of the Middlesex Electric Company, the Edison Electric Illuminating Company, the Raritan Electric Light and Power Company, the Rahway Electric Company, and the Bound Brook Electric Light and Power Company.

NEW POWER SITES ON THE SAVANNAH RIVER—The division of hydrography of the United States Geological Survey has had a party of engineers investigating the power possibilities of the Savannah river. A number of advantageous power sites has been located. Among these are the following: at Little river shoals, where the stream has a fall of four and one-half feet a mile, power can be easily developed, and the high rock bluff on the right-hand bank affords ample protection for a power-house. Scott's creek at this point would serve as a short tail-race. The river is about 2,000 feet wide. At this point it is very shallow and swift, and apparently has a good rock bed over its entire length. There is a narrow strip of bottom land above the dam site on the other side. A number of good dam sites were found on Long shoals, one about half a mile above Kilkrese Ferry. The river here is divided by Price Island, a part of which is under cultivation. A rock ledge runs across the river and gives a fall of two feet in 100; and a solid rock cliff which runs down almost to the edge of the water affords an excellent abutment, and will furnish rock in abundance for the construction of the dam. A forty-foot dam could be built here, though the abutment and local conditions seem more favorable for a fifteen-foot structure. Just above Dorden creek there is a good site for a dam, both abutments being solid rock cliffs. The river is about 1,300 feet wide, swift, shallow, and apparently has a good rock bed. The abutment on the left bank is 100 feet from the water's edge, and below it is an excellent site for a power-house, etc. A twenty-five-foot dam could be constructed at this point, but fourteen feet will develop the rest of Long shoals, and a higher dam would damage a considerable part of the bottom lands above.

ELECTRIC LIGHTING.

HARRISBURG, PA.—The Rockwood Electric Company, of Rockwood, Somerset County, has been organized with a capital of $20,000.

DES MOINES, IOWA—The Nevada Electric Light Company is seeking to have its franchise extended, and if it is successful will rebuild its system.

SANTA FE, N. M.—The Capital Light and Power Company has let the contract for the construction of the pole line from the power site on the Pecos river to Santa Fe, fourteen miles, and to Las Vegas. Ground has been cleared for the construction of the power-house, and excavations for the foundation are under way. At first only 5,000 horse-power will be developed.

BLOOMINGTON, ILL.—At a special meeting of the Normal city council an ordinance was passed providing for the transferring of the charter of the Normal Electric Light and Power Company to the Bloomington & Normal Railway, Electric and Heating Company. The company's contract with Normal is to run for five years, the company to receive $52.50 per lamp per year for the sixty or more lamps furnished by it; and the company agrees to pay the town of normal $2.50 in cash for each light provided for in the contract or hereafter installed. The above agreement is made on the condition that the Bloomington & Normal Railway and Heating Company procure an assignment to it of a franchise granted to the Normal Electric Light and Power Company, which is said to have been arranged for.

TROY, N. Y.—The work of laying the conduits for the wires to connect the power plant at Spier Falls with the Albany electric light station is progressing, and it is expected will be completed shortly. It is thought that the power will be supplied in the city by January 1. The conduit is laid as far westward from the river as possible in order to avoid damage by high water in the spring freshets. The conduits lead to the towpaths, by way of which wires are strung to Mechanicville and Spier Falls. Twelve ducts are being laid, each capable of holding twelve wires. Only six wires will be used for the present. Along the canal the wires will be carried by poles. A new building is being erected at Albany and machinery installed that will cost $40,000. This will consist of three motors, two converters and four transformers. Five thousand horse-power will be furnished as a starter. This will be gradually increased. The entire output of the Spier Falls plant, except 10,000 horse-power, which will go to Schenectady, has been contracted for by the Albany Electric Illuminating, the United Traction and the Troy Gas companies.

PERSONAL MENTION.

MR. CAPEL HOLLAND has resigned as president and general manager of the People's Telephone Company, Morgantown, W. Va.

MR. H. H. GEARY, sales manager of the Fostoria Incandescent Lamp Company, Fostoria, Ohio, has been in New York visiting during the past week.

MR. E. M. MULLIGAN, city engineer of Warren, Ohio, has been appointed consulting engineer in charge of construction of the Cleveland & Eastern Electric Railway.

MR. WILLIAM F. DURAND, professor of marine engineering, has been appointed acting director of Sibley College, Cornell University, in place of the late Professor Thurston.

MR. J. W. CAMP, general superintendent of the Canadian Pacific Railway Telegraph Company, has been appointed electrical engineer, with jurisdiction over the entire system.

MR. D. A. SCHUTT, superintendent of the Peru Electric Manufacturing Company, Peru, Ind., for the past twelve years, has tendered his resignation, to take effect January 1.

MR. H. M. SHIPE has been appointed fellow in electrical engineering at the Toronto School of Practical Science, and Mr. Silas B. Wass has been made fellow in mechanical engineering.

MR. O. F. FRENCH, who has been acting general manager of the Cuyahoga Telephone Company, Cleveland, Ohio, since the resignation of Mr. Turner, has been made the general manager of that company.

MR. W. McL. WALBANK, formerly general manager of the Lachine Hydraulic and Land Company, Montreal, has been appointed first vice-president and chief engineer of the Montreal Light, Heat and Power Company.

DR. F. A. C. PERRINE, of the Stanley Electric Manufacturing Company, Pittsfield, Mass., will deliver the Founder's Day address, November 30, 1903, at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y.

MR. JACOB CLOOS, formerly technical manager of the Milwaukee Edison Company, has been appointed manager of the Milwaukee office of the Downward Light Electric Company, which will cover Wisconsin and Iowa territory.

MR. EDWARD LYNDON has resigned his connection with the Gould Storage Battery Company, of New York city, and is now engaged on technical work for his brother, Mr. Lamar Lyndon, the well-known consulting engineer, New York city.

MR. F. G. BOLLES, who has for some years been prominently connected with the Bullock Electric Manufacturing Company as manager of the advance department, has severed connections with that company to assume the management of *Cassier's Magazine*.

MR. ROBERT O. CUMBACK, for several years with the Central Railroad of New Jersey, and now located at the Elizabeth shops on special work, has accepted the position of superintendent of the new plant of the Pedrick & Ayer Company, located at Plainfield, N. J.

MR. PHILIP H. DEWITT, member of the American Society of Civil Engineers, has tendered his resignation as assistant engineer of the New York Central & Hudson River Railroad, to accept a position of consulting engineer with G. B. Markel & Company, Jeddo, Pa.

MR JAMES H. FOSTER, formerly secretary of the Evansville Gas and Electric Light Company, has been elected treasurer in the place of Mr. Henry Reis, who has resigned. The office of secretary has been combined with that of general manager, and Mr. W. B. McDonald was reelected.

MR. S. D. CUSHING, son of the late General Samuel Cushing and a graduate of Lehigh University, has been promoted to the office of electrical engineer in charge of the electric power plants and block signals of the Southern Railroad Company. Mr. Cushing's office will be in Washington, D. C.

MR. L. R. ZALLINGER, who has been appointed principal assistant engineer of the Pennsylvania Railroad at Altoona, to succeed Mr. Johnston, is a graduate of Lehigh University. Mr. Zallinger started working for the Pennsylvania Railroad in 1889 as a rodman and has been with that company ever since.

MR. P. WERNER, who has been with the Allis-Chalmers Company, at Milwaukee, for seven years as designer and in charge of some of its works, and who was for one year general superintendent of the Filer & Stowell Company, Milwaukee, has taken the position of chief engineer at T. and C. G. Bolinders, Mek. Verkstad, Stockholm, Sweden.

PROFESSOR H. S. HELE-SHAW, who holds the chair of engineering at Liverpool University, has been appointed, through the Colonial Office, to organize technical education in the Transvaal and the Orange river colony. The appointment is not a permanent one, and Professor Hele-Shaw has been granted leave of absence by the university council until September next.

MR. GEORGE F. MADDOCK, assistant professor of electrical engineering at Stanford University, Cal., has resigned his position to become superintendent of the Ide engine works at Springfield, Ill. He will be succeeded at Stanford University by William R. Echart, Jr., a graduate of Cornell. Mr. Echart has been in San Francisco engaged in central station designing and testing.

COLONEL ROSWELL EATON GOODELL died on October 21 in the city of Denver, Col. Colonel Goodell was a conspicuous figure in the railway world in the early fifties, at that time being superintendent of the Chicago & Alton Railroad. It was he who executed, on behalf of the railroad company, the first contract made with the late George M. Pullman for Pullman sleeping cars.

DR. HANS GOLDSCHMIDT, of Essen, Germany, on the evening of Friday, November 13, delivered an address, illustrated with experiments, upon alumina thermics, or the production of high temperature by burning alumina and the application of this to metallurgy and engineering. The address was given before the Columbia University Chemical Society in Havemeyer Hall, Columbia University.

MR. R. C. VAN NESS, general manager of the Lincoln (Nebraska) Gas and Electric Company, has been asked by President Edgar, of the National Electric Light Association, to report to the twenty-seventh convention of the association, to be held in Boston next May or June, on lost and unaccounted-for current. Mr. Van Ness has been giving this subject considerable study, and hopes to make a valuable and interesting report.

MR. FREDERIC L. THORNE has severed his connection with the Westinghouse Companies' Publishing Department. Mr. Thorne was originally located at Pittsburg with the company, but has recently been associated with the New York office. He will probably not make any new connection before the first of the year, but has in view several attractive propositions. Mr. Thorne has been successful not only in the technical field of literature, but also as a special writer on varied subjects.

MR. JOHN CALDER, who has been with the C. W. Hunt Company, West New Brighton, N. Y., as its executive engineer, left on Saturday, November 14, for Ilion, N. Y., where he will be connected with the management of the Remington Typewriter Company. The members and employés of the C. W. Hunt Company presented Mr. Calder with a handsome silver loving cup, suitably inscribed, Mr. George Humphrey making the presentation remarks and assuring Mr. Calder of the appreciation and esteem of his associates.

PROFESSOR SYLVANUS P. THOMPSON, F. R. S., delivered an address on Tuesday, November 3, at the Hampstead Conservatory, London, England, on wireless telegraphy. The lecturer gave a brief résumé of the history of the science, including the earlier experiments of Morse, Lindsay, Preece, Edison and Tesla. A number of interesting illustrations was shown, and the lecture concluded with the transmission of a message selected by a member of the audience, between a near-by station and the lecture room. The apparatus used on the occasion was that employed in the Lodge-Muirhead system. Dr. Thompson advocated an international agreement with regard to the reception of wireless signals, and said that there was no foundation for the newspaper talk that wireless telegraphy had been the cause of bad weather.

ELECTRIC RAILWAYS.

COVINGTON, KY.—It is stated that a plan has been revived to build an electric railway from Ludlow to Covington, which will connect the Cincinnati Southern, the Chesapeake & Ohio, and the Louisville & Nashville.

SPRINGFIELD, ILL.—The Mississippi Valley Traction Company has been incorporated with a capital of $600,000. The principal office is to be at Moline. The object is to construct an interurban line from Moline to Geneseo, Ill.

MARION, ILL.—Officials of the Coal Belt Electric Railway system, connecting all principal towns in Williamson County, have decided to extend their line to Johnston City, six miles north, and Harrisburg, twenty-five miles east. Most of the right of way has been secured.

ST. LOUIS, MO.—Plans have been completed by the Suburban Railroad for the building of a large power-house. The building will be a one-story brick structure, 193 by 131 feet, and will cost $55,000. A permit has been issued and building operations will be started at once.

ITHACA, N. Y.—Promoters are investigating the feasibility of a proposed trolley route from Ithaca to Horseheads *via* Enfield Falls, Enfield to county line within a mile of Mecklenburg, and *via* Cayutaville, Cayuta Lake and Odessa. It is estimated the road would cost somewhere in the neighborhood of $800,000.

BANGOR, PA.—The Bangor, East Bangor & Portland Street Railway Company has purchased the plant of the Bangor Electric Light, Heat and Power Company. The trolley company intends making some alterations, after which it will extend the line from the present terminus at Portland to the Delaware Water Gap and Stroudsburg.

COLUMBUS, OHIO—Articles of consolidation have been filed with the secretary of state by the Youngstown & Southern Railway Company, and the Youngstown & Salem Railway Company. The capital stock is $1,800,000. The incorporators are A. W. Jones, John H. Ruhmann, W. H. Ruhmann, J. R. Long, W. S. Andrews and R. L. Andrews.

MORGANTOWN, W. VA.—The Fairmont, Morgantown & Cheat River Railroad Company has purchased of the Union Utility Company its trolley line on the west side of the Monongahela river. The line is two miles long and extends to Granville. The Fairmont, Morgantown & Cheat River Company declares its intention to extend the line into Fairmont at once.

MARION, IND.—Another electric line is being projected to enter Marion, Ind., and it is stated that all the right of way has been secured from Dayton to Celina, Ohio. It is intended to bring the road through Marion from Celina to Portland. From Portland the line would run direct to Hartford City, and then parallel the Panhandle from that city to Marion and then to Kokomo.

DANVILLE, ILL.—Articles of incorporation of the Hoopeston Street Railway and Light Company have been filed in the office of the county recorder. The directors of the company are James H. Dyer, John L. Hamilton, Alfred H. Trego, Charles S. Crary, J. S. McFerren and Charles A. Allen. The charter entitles the company to operate an electric street railway system in the city of Hoopeston.

LIMA, OHIO—The Cincinnati, Hamilton & Dayton Railway has started the work of converting its Findlay-Deshler line into an electric road. Previous to the acquisition of the Findlay, Ft. Wayne & Western, this line connected Findlay with the main road, but such connection is now made *via* Ottawa over the Ft. Wayne branch, and electric cars will substitute steam on the former branch.

YOUNGSTOWN, OHIO—The Salem & East Railway Company has been incorporated with a capital of $5,000. The incorporators are E. S. Cook, F. S. McGowan, A. S. Banner, J. W. Tyler and M. L. Fowler. The company proposes to build an electric line from Sebring to Salem and East Palentine, with a branch to Salem. The capital stock will be increased as soon as the preliminary survey has been made.

GREEN BAY, WIS.—The power-house and car barns of the Knox Construction Company's interurban line between Green Bay and Kaukauna will be located in this city, on the property owned by the Fox River Electric Railway and Power Company and the Buscher property adjoining, which has been purchased for the purpose. The location of the buildings here means the expenditure of over $100,000.

MYSTIC, CT.—The Groton & Stonington Street Railway Company, which is about to build a trolley line from New London to the Rhode Island state boundary at Westerly, has purchased of the Standard Machine Company the so-called Randall wharf property as the site for a power station. The dimensions of the tract are 150 by 225 feet, and the site borders on the Mystic river, whose channel, at low tide, has a depth of sixteen feet.

CADILLAC, MICH.—The Cadillac Traction Company has been organized here and has filed articles of incorporation, fixing the authorized capital at $250,000. The company will operate a street railway and electric light plant. The promoters are: President, W. J. Cornwell; vice-president, J. F. Vosberg; secretary, George S. Stanley; treasurer, Francis O. Gaffney; superintendent and general manager, J. H. Orr. Work on the roadbed will begin soon.

GEORGETOWN, DEL.—J. Stanley Gardner, of New York, who is financing the Sussex County trolley lines, has been going over the route with electricians and Major Calhoun, the engineer. It has been decided to commence work on the Lewes end of the route, and to complete the system before July 1 of next year. The route agreed upon extends from Seafoord to Georgetown, and thence to Rehoboth by way of Hollyville and Midway, connecting also at Midway and Lewes. In addition, there is to be an attractive seashore route from Lewes to Rehoboth.

ANNISTON, ALA.—It is understood here that Birmingham gentlemen will build an electric railroad from Pyriton to Lineville, a distance of seven miles. The road will give Lineville railroad facilities to the outer world, if built, as it will connect at Pyriton with the Eastern of Alabama. The Eastern Railroad has just been completed and runs from Talladega to Pyriton, a distance of about twenty-one miles. Trains were operated over the road the first of September for the first time and connections are made with the Louisville & Nashville trains of the Alabama Mineral Division.

BUFFALO, N. Y.—The actual work of extending the Buffalo & Depew trolley road from Depew to Rochester has been begun. The construction headquarters are at Pembroke, Genesee County, about half way between Depew and Batavia, and the work will be extended both east and west from that point. The line from Buffalo to Rochester will be run through Depew, Lancaster, Looneyville, Wende, Crittenden, Corfu, West Batavia, Batavia, Stafford, LeRoy, Caledonia, Mumford, Clifton and Chili to Rochester. When completed the trolley line will be sixty miles long. It is expected to be finished and in operation about two years from the present time.

GUTHRIE, OKLA.—Articles of incorporation have been signed in Oklahoma City for the Blue Island, Riverside & Hammond Street Railway Company, the home office of which will be in Oklahoma City. It is capitalized at $1,500,000. The directors are William F. Owen, August W. Miller, John F. Noel, Ira J. Owen, W. S. McCaully and Frank E. White, of Chicago; W. F. Harn, J. F. McMechan and John Throadgill, of Oklahoma City. The purpose for which the corporation is formed is to build, operate and own a line of street railway from West Pullman, Cook County, Ill., through Harvey, Phœnix, South Holland, Calumet, Thornton, Chicago Heights, Steger, Crete, Joliet, also a cross line from Blue Mound, through Calumet, Riverdale, Dalton, Thornton and West Hammond.

VINCENNES, IND.—It is stated that the Vincennes-Jasper Electric Railway will be built within a year and will cost about $1,000,000. A deal has been closed with the Cincinnati Municipal Bond and Securities Company, whereby the company takes up the securities of the road. The management will employ a Cincinnati construction company to build the road, and within ninety days proposes to have at least 500 men at work on the road-bed. There will be fifty-four miles of the road from this city to Jasper, the capital of Dubois County. Much hilly country will be traversed, especially in Harrison township, this county, after passing through Monroe City. From Monroe City the road will pass through Petersburg, Pike County, on to Jasper. The road will be the means of developing a rich section of the state. The out-of-town capitalists present were: Smiley N. Chambers, of Indianapolis; Sol Frank, F. E. Campbell and John A. Davis, of Petersburg, and E. F. Cox, of Worthington, engineer of the road.

LEGAL NOTES.

INDUCTION MOTOR LITIGATION—In the suit of the Thomson-Houston Electric Company, complaint, *vs.* the Dayton Fan and Motor Company and E. O. Waymire, defendants, in the United States Circuit Court, Southern District of Ohio, Western Division, Judge Thompson filed an opinion on November 2, 1903, against the defendants. This is a suit to enjoin the infringement of U. S. letters-patent Nos. 363,186, 399,801 and 428,650, on the Thomson induction motor.

LEGAL STATUS OF A WATER POWER COMPANY—A corporation authorized to develop and use the water power of a river and generate electricity or other power, light or heat, and utilize, transmit and distribute it for its own use or the use of other individuals or companies, is held, in Fallsburg Power and Manufacturing Company *vs.* Alexander (Va.) 61 L. R. A. 129, to be for a private, and not a public, purpose, and therefore not entitled to exercise the right of eminent domain.

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—Whitley Telephone Company. $100,000.

HARRISBURG, PA.—The Gayly Local Telephone Company. $5,000.

MARYSVILLE, PA.—Marysville Electric Light Company. $10,000.

BUFFALO, N. Y.—Robertson Electric Company. Increased from $20,000 to $50,000.

PITTSBURG, PA.—Pittsburg Connecting and Terminal Railroad Company. $25,000.

HARRISBURG, PA.—Pittsburg, Summerville & Clarion Railway Company. $150,000.

ALBANY, N. Y.—The Niagara Falls Power Company. Increased from $9,500,000 to $10,500,000.

AUSTIN, TEX.—The Denison & Sherman Railway Company. Increased from $100,000 to $200,000.

INDIANAPOLIS, IND.—Indianapolis & Northwestern Traction Company. Increased to $3,000,000.

BLANCHARD, IOWA—Blanchard, Coin & College Springs Mutual Telephone Company. $3,000.

RICHMOND, VA.—Montford Telephone Company. $10,000. Incorporators: D. Sharp Butler and Barney Butler.

FULLERTON, NEB.—The Fullerton Electric Light and Power Company has been incorporated. The capital is $20,000.

SAGINAW, MICH.—The Boyne City Electric Company, of Grand Rapids, Mich., capital $10,000, has been incorporated.

TEXARKANA, TEX.—Long-Distance Telephone Company. $200,000. Incorporators: John B. King, W. L. Estes, F. M. Marriatt.

JERSEY CITY, N. J.—Scott Snell Lighting Company. $250,000. Incorporators: S. B. Timmonds, A. B. Eilback, Charles Schegel.

SPENCER, OHIO—The Spencer Telephone Company. $5,000. Incorporators: F. T. Cavin, N. E. Fuller, John Firestone and others.

RALEIGH, N. C.—The Home Telephone and Telegraph Company. $500,000. Incorporators: W. T. Gentry, of Atlanta, and J. P. Taylor, of Henderson.

DENVER, COL.—The Shawnee Light and Power Company. $200,000. Directors: E. A. Paulson, Otto Kaffler, John B. Sibley, D. J. McCannie and J. Cuthbert Sweeney.

ALBANY, N. Y.—Brookhaven Electric Light Company. $50,000. Directors: Charles A. Squires, Orange T. Fanning, Thomas O'Donnell, Charles F. Randall, of Port Jefferson, and H. C. Losee, of Patchogue.

INDIANAPOLIS, IND.—Indiana Central Traction Company. $50,000. To build an electric road from Wabash to Warsaw, *via* North Manchester and Winona Lake, and from Connersville, *via* Liberty, to the state line.

HARRISBURG, PA.—The O'Connell Railroad Company; $40,000; to build a line of railroad in Chester County. The Overbrook, Bryn Mawr & Paoli Street Railway Company; $138,000; to build an electric road from Lower Meredith to Narbeth Station.

BALTIMORE, MD.—A charter for the Virginia Power Corporation, with a capital of $500 to $50,000, has been filed at Staunton. C. Russell Caldwell is president, and Lawrence H. Peyton, Herbert J. Taylor, of Staunton; J. J. Nicholas, of Port Republic, and John Fulton, of Mount Meridian, constitute the board of directors.

ELECTRICAL SECURITIES.

Notwithstanding the fairly good bank statement made Saturday, the bear manipulators in Wall street were able to still further depress stocks, so that the net results for the week show additional declines. The bank statement showed a loss of less than $3,000,000 sustained by the clearing house institutions, and the bank loan account decreased $10,240,500, making an actual small gain in the bank surplus during the week. Previous to the publication of the statement, the stock market had been hard and firm, though with no special activity; but as soon as it was made public, the market was assailed and considerable stock sold off, so that at the close of the market most of the active issues had suffered. A number of industrial corporations, which had either shut down or were contemplating extreme retrenchment in their operations, have decided upon a policy of working as much ahead as possible, this being made more agreeable by large numbers of the employés accepting, without dissatisfaction, a moderate reduction in pay.

The construction of so large a piece of engineering as the Panama canal, which seems very probable in the near future, will not fail to stimulate interest in every industry which is affected by work of this character. This, together with the known value of the completed canal as a commercial factor, should aid largely in sustaining a healthy state of trade until the present apathy shall have been dissipated.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 14.

New York:	*Closing.*
Brooklyn Rapid Transit	36⅝
Consolidated Gas	175
General Electric	147½
Kings County Electric	160
Manhattan Elevated	138½
Metropolitan Street Railway	112
New York & New Jersey Telephone	140
Westinghouse Manufacturing Company	165

The balance-sheet of the Interborough Rapid Transit Company as of September 30, 1903, is as follows:

Assets—Cost of lease and equipment of subway, $7,080,800; stock and bonds, $13,527,265; real estate, $1,400,176; supplies on hand, $696,147; due by agents, $85; due by others, $8,761; open accounts, $139,059; cash on hand, $10,717,870; Manhattan guarantee fund, $4,018,812; prepaid insurance, $7,999; sundries, $4,813; total, $37,601,790. Liabilities—Capital, $35,000,000; interest due and accrued, $171,413; sundries, $4,704; Manhattan Railway lease account, $409,451; due for wages, $117,159; due for supplies, taxes, etc., $410,459; open accounts, $19,039; interest and premium on capital stock, $404,297; taxes in litigation, $303,000; profit and loss (surplus), $762,267; total, $37,601,790.

Boston:	*Closing.*
American Telephone and Telegraph	124½
Edison Electric Illuminating	240
Massachusetts Electric	76
New England Telephone	123
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	7⅜
Electric Storage Battery common	46
Electric Storage Battery preferred	46
Philadelphia Electric	5⅜
Union Traction	43½
United Gas Improvement	78

Chicago:	*Closing.*
Chicago Telephone	122
Chicago Edison	140
Metropolitan Elevated preferred	55
National Carbon common	17
National Carbon preferred	85
Union Traction common	5½
Union Traction preferred	28

INDUSTRIAL ITEMS.

THE EUREKA ELECTRIC COMPANY, Genoa, Ill., announces that it has ready for distribution Bulletins 26 and 27. These will be sent on request.

THE MILLER ANCHOR COMPANY, Norwalk, Ohio, manufacturer of the Miller anchors, augers and excavation buckets, will make a fine display at the convention of the Interstate Independent Telephone Association, at the Auditorium Hotel, Chicago, Ill., December 8, 9 and 10.

THE YOST ELECTRIC MANUFACTURING COMPANY, Toledo, Ohio, advises that it is now completing a large addition to its factory and that during the coming season its facilities for manufacturing will be vastly increased. This company now manufactures the Yost socket and other special electrical appliances.

THE ALLIS-CHALMERS COMPANY, Chicago, Ill., is distributing Catalogue No. 62. This gives a list of the foreign users of Corliss engines, pumping engines, hoisting engines, compressors and blowing engines. A number of half-tone illustrations show typical installations of Reynolds engines of every description.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for Packard lamps and transformers, is sending out some literature describing the new "Salus" compound, with which the Packard transformers are insulated. The company will be pleased to send this pamphlet and its latest transformer catalogue on request.

THE HOBART ELECTRIC MANUFACTURING COMPANY, Troy, Ohio, is distributing two pamphlets descriptive of its gas engine type of dynamos, and protected and invertible direct-current dynamos and motors. The gas engine type dynamos are suitable for from 8 to 300 lights, and the direct-current dynamos range from one-half to twenty kilowatts, and the motors from one-half to twenty-five horse-power.

THE UNITED TELPHERAGE COMPANY, Westfield, N. J., is distributing a new series of bulletins descriptive of telpher operations in various industries. Bulletin No. 36 describes telpherage in cotton and woolen mills; No. 38, automatic telpher plants; and No. 42, reserve coal storage and the handling of coal, coke and ashes for gas and electric light companies and factories and mills. These bulletins may be had on application.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, will be pleased to send its catalogue of brass and iron engineering appliances to any one interested in this material. The Lunkenheimer regrinding valves in screw and flange ends, one-eighth of an inch up, for 200 to 350 pounds working pressure, are largely used on the United States battleships, cruisers, torpedo boats, locomotives, lake and river boats and on high-pressure plants everywhere.

THE VICTOR ELECTRIC COMPANY, Chicago, Ill., in its catalogue No. 21 describes a line of electrosurgical apparatus. This includes cautery transformers, ear and eye masseur pumps, shunt current controllers, air compressors, sinusoidal machines, Finsen ray outfits, wall plates and cabinets, surgical drilling engines, motor-generators, head lamps, vibratory massage apparatus, motors, rheostats, eye magnets, etc. The eastern agent of the Victor Electric Company is the Union Electric Company, Baltimore, Md.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., will be pleased to send any one interested, upon request, an illustrated pamphlet describing the mechanical equipment of the Orange brewery, at Orange, N. J. Two electric generating units are used in this equipment—one of sixty kilowatts, and one of thirty kilowatts. The plant is a model in every way, and makes liberal use of electrical apparatus, all of which has been supplied by the Crocker-Wheeler Company, except that included with machinery under special contracts.

THE DOWNWARD LIGHT ELECTRIC COMPANY, 225 Fourth avenue, New York city, announces that Mr. Jacob Cloos, one of the best-known electrical engineers in the Northwest, formerly technical manager of the Milwaukee Edison Company, has been appointed manager of the Downward Light Electric Company's Milwaukee office, which will cover Wisconsin and Iowa territory. The office will carry a large stock of tipless downward light lamps, as well as oval anchored filament lamps, which are labeled "Sidelight." The Milwaukee office is located in the Matthews Building.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing an attractive booklet entitled "Dixon's Graphite Suggestions." The cover page of this booklet is embellished with a drawing in colors of several ancients marking on the wall with graphite. This attractive little booklet sets forth the advantages and infinite diversity of graphite, giving a short history of the Joseph Dixon Crucible Company and its connection with American graphite, graphite pencils, crucibles, in the foundry, for lubrication, graphite for bicycles and automobiles, for power launches, pot lead for yacht bottoms, for electricians' use, for domestic use, belt dressing, graphite paint, and as a pipe joint compound.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that a freight station has been established at Ampere, N. J., by the Delaware, Lackawanna & Western Railroad Company. All goods should therefore be addressed "per D., L. & W. R. R." A daily through car service has been established between Ampere and pier 41 North river, New York, foot of Le Roy street. All goods for the Crocker-Wheeler Company from New York and points east should be delivered at the Le Roy street terminal, pier 41 North river, New York. The receipt of freight closes at this point at 4.30 P. M., and the goods will arrive at Ampere the next morning. The receipt of freight at Ampere closes at 5 P. M. and the goods will arrive at pier 41 North river the next morning.

SMITH & HEMENWAY COMPANY AND UTICA DROP FORGE AND TOOL COMPANY, 296 Broadway, New York, publisher of the "Green Book of Hardware Specialties," has subdivided this book into four sections, uniquely and attractively printed on a green French folio paper. These sections, "Glaziers," "Electrical," "Razor" and "Caster," were printed in compliance with the request of many customers, to get up a catalogue small enough to be conveniently carried in the pocket. This progressive firm is ever on the alert for an attractive catchiness in its advertising, and in these subdivisions of its "Green Book of Hardware Specialties" has presented something that is not only attractive but useful, and the light weight of paper on which they are printed makes them fit so snugly in the pocket that they are always carried, and constantly used for reference.

THE REPUBLIC RUBBER COMPANY, Youngstown, Ohio, is distributing an elaborate advertising folder entitled "A Talk on Packing." This company is the manufacturer of "Searchlight" packing. The claim is made that a flanged joint made with this packing is not disturbed or displaced by any vibration of the main steam line. Its nature is yielding, and, at the same time, it is tough, strong and elastic. The composition is such that it will conform readily to the roughness of any irregular flanged surface, and requires no metal or wire insertion to make a tight joint. Another specialty manufactured by this company is the cross-arm tubular gasket. A brass wire mesh runs through the centre of the gasket, and when heat is applied, the wire is embedded into the rubber. Another feature is that the sleeve is a specially prepared composition of minerals and copper, so that when the heat is applied in connection with the rubber it vulcanizes solid, making a perfect gasket without a break or joint.

THE FORT WAYNE ELECTRIC WORKS, INCORPORATED, Fort Wayne, Ind., manufacturer of the "Wood" systems, is distributing several handsome catalogues dealing with "Wood" type apparatus. Bulletin No. 1049 describes and illustrates types MP and MPL direct-connected direct-current generators, and gives a list of operators of these machines. Bulletin No. 1050 describes and illustrates direct-connected type MPL direct-current generators for power and lighting. This bulletin contains a number of splendid half-tone reproductions of these direct-connected generators in typical installations. There is also an index to bulletins, including Nos. 1001 to 1050. This is a valuable addition to the Fort Wayne literature, as it brings within easy range all of the valuable bulletins which this company has published. Catalogue of parts, No. 2008, gives in detail the assembly of power circuit form C "Wood" arc lamps, while catalogue of parts No. 2009 gives the assembly of direct-current 110-volt form C "Wood" arc lamps.